Radio for Everybody pages 298, 304, 356

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy | MAY 1922 | $4.00 a Year

WITH WATERPROOF PAINTS AND CANVAS: PAINTING A SUBMARINE SCENE AT FIRST HAND.—[See page 319]

Scientific American Publishing Co., Munn & Co., New York

A Purely Mutual Organization

New York Life Insurance Co.

(Incorporated under the Laws of New York)

346 BROADWAY, NEW YORK, N. Y.

Seventy-Seventh Annual Statement

DARKIN P. KINGSLEY, President

Balance Sheet, January 1, 1922

Securities at Market Value as furnished by Insurance Dept., State of New York

ASSETS		LIABILITIES	
Real Estate	$8,362,881.00	Policy Reserve	$787,157,463.00
Mortgage Loans	183,722,805.92	Other Policy Liabilities	28,527,025.08
Policy Loans	164,305,141.17	Premiums, Interest and Rentals Prepaid	4,361,995.18
Collateral Loans	2,301,000.00	Taxes, Salaries, Rentals, Accounts, etc.	7,549,037.63
Liberty Bonds and Victory Notes	120,628,900.00	Additional Reserves	7,485,874.00
Government, State, Province, County and Municipal Bonds	155,439,933.50	Dividends Payable in 1922	42,287,368.71
Railroad Bonds	271,524,487.07	Reserve for Deferred Dividends	59,303,179.00
Miscellaneous Bonds and Stocks	7,325,003.00	Reserves, special or surplus funds not included above	15,960,196.20
Cash	11,067,144.16		
Uncollected and Deferred Premiums	14,674,443.08		
Interest, and Rents due and accrued, etc.	13,280,399.90		
Total	**$952,632,138.80**	**Total**	**$952,632,138.80**

Paid to and on Account of Policy-holders during 1921	$124,308,409.00
Loaned Policy-holders during 1921 under Policy Contracts	40,871,382.00
Loaned on Farms during 1921	15,004,330.00
Loaned on Mortgages for housing purposes during 1921	9,646,991.00
Loaned on Business Property during 1921	11,358,909.00

The earning power of Ledger Assets, including Cash in Bank, advanced 0.16% during the year

BOARD OF DIRECTORS

LAWRENCE F. ABBOTT
ALFRED L. AIKEN
JOHN E. ANDRUS
CORNELIUS N. BLISS, Jr.
NICHOLAS MURRAY BUTLER
GEORGE B. CORTELYOU
JOHN H. FINLEY
DAVID R. FRANCIS
A. BARTON HEPBURN
MYRON T. HERRICK
GRANGER A. HOLLISTER
ALBA B. JOHNSON
WILLARD V. KING
DARWIN P. KINGSLEY
RICHARD I. MANNING
JOHN G. MILBURN
GERRISH H. MILLIKEN
FRANK PRESBREY
JOHN J. PULLEYN
FLEMING H. REVELL
GEORGE M. REYNOLDS
ELBRIDGE G. SNOW
HIRAM R. STEELE
OSCAR S. STRAUS
S. DAVIES WARFIELD

With the Editors

THIS is our seventh issue in the new monthly form. Indeed, most of us have all but forgotten the old weekly SCIENTIFIC AMERICAN, and the editors for their part retain but a dim recollection of the former routine of getting out a weekly edition instead of the present monthly. With six issues of the monthly behind us, we feel quite familiar with our present task and realize more and more the advantages of a monthly issue. In our present form each successive issue presents still greater opportunities, and we mean to take advantage of them.

IN a journal with as broad an editorial scope as ours, it is imperative that we maintain at all times a strict sense of balance. It is so easy to have our journal become too partial to one field or another, at the expense of all the remaining fields. Especially is this true when there is unusual activity or interest displayed in one particular field, and the natural tendency is to devote page after page to that field to the detriment of the remainder of our editorial contest. Radio is a case in point. We all know and appreciate that radio is the subject of the hour. Everyone is speaking about radio; radio manufacturers are working night and day to keep up with the demand for apparatus; authors are working at top speed on a dozen or more radio books scheduled to appear within the next few weeks; a half dozen new radio magazines are expected on the newsstands almost any day. We are frank to confess that in the face of all this activity and stupendous interest in the subject, we have been seriously tempted to become editorially unbalanced; that is to say, to devote an undue share of our editorial space to radio. For a while we considered a special radio department, containing the various bits of news about broadcasting stations, new apparatus, etc. Also have we considered running several radio articles in every issue. But after studying the matter most carefully, we believe it to be the part of better judgment to devote only sufficient space in every issue to cover the outstanding developments of the art, leaving the average news items and radio-phone broadcasting announcements and construction data to journals which specialize in this subject. We are going to content ourselves with the big things in radio, in this general magazine of ours; but we are also going to cover the details and specific data in books and pamphlets, in order that such of you as may be specially interested may receive from the SCIENTIFIC AMERICAN the information you require.

SO our first supplementary publication on radio is a book entitled "Radio for Everybody," which is an outcome of the article recently published in our columns under that title, as well as of the numerous inquiries we have received from our readers. This book endeavors to tell about popular, every-day radio in the layman's own language. It is assumed that the reader knows nothing about alternating current and wave forms, variometers and wave decrements; yet, starting with the very elements of radio communication, he is taken step by step through the simplest to the most elaborate receiving sets, amplifiers, loud-speaking devices, spark transmitters, radio-telephone transmitters, and finally to the business aspect of present-day radio. The book gets down to the specific details which we would publish in the SCIENTIFIC AMERICAN had we the required space to do so. However, in view of the general scope of our journal and in fairness to all the other fields which we must cover, we again repeat that the outstanding features of radio will be covered in these columns, and specific information on all phases of radio will be handled in supplementary publications. "Radio for Everybody," the first of these supplementary publications, is now ready for distribution as announced this month in our advertising columns.

RECOLLECTION fails to bring to mind any time at which we have had so much really fine material in definite prospect. Dr. Carrington, for instance, has completed another article on the psychic, in which he deals with raps, knockings, displacements of objects, and other material phenomena of psychic origin, doing for these more or less what Mr. Bird does for the mental side of the case in the current issue. Two at least, and probably three, articles will follow Mr. Claudy's of page 314, in which members of our staff and outside engineers will explain the workings of specific systems of automatic train control. Among the very interesting stories on the editorial schedule for early appearance are an account of the ice patrol in the North Atlantic, by means of which, if the warnings are heeded, any repetition of the "Titanic" disaster will be out of the question; and a description of a brand-new method for keeping an obstreperous river within its banks, which has been tried out already with success on no less formidable a stream than the Father of Waters. Psychology is being put on a definite commercial basis, so that the individual who wishes an examination of any sort, or the corporation that wishes systematic tests conducted, may call in the psychologist with as much convenience and as much assurance as though the need were for a mining engineer; and we shall tell the story of how this is being done, and how it is being done in a manner certain to react favorably upon our sum of knowledge. We shall have an entertaining story of the scientific frauds—alchemy, synthesis of gold, and the like—which at the moment are sweeping over Europe. And we shall have the usual number of good things that come too late to be announced save by their presence in our pages.

SUBATOMIC investigation and theorizing is the order of the day, as those familiar with the work of Langmuir and Aston, to mention but two names, are aware. The ordinary story dealing with these subjects suffers from inadequate illustration. The text cannot in the very nature of things stand on its own feet without pictures; and pictures, again in the nature of things, must be conventional drawings of some sort, devoid of life and lacking in true pictorial interest. In the effort to overcome this, the research staff of the Schenectady laboratories has worked up, in animated cartoon fashion, a motion picture showing what really takes place below the threshold of visibility, among the atoms and electrons. We cannot, of course, retain the motion when we exhibit selections from this film in our pages, nor can the makers get away from the necessity of using drawings rather than real pictures. Nevertheless, we are sure that the article based on these movies which will appear in our June issue will give our readers an insight into modern atomic and subatomic hypotheses which they have never before been able to get.

CONTENTS

MAY, 1922

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Munn & Company, 233 Broadway, New York
Founded 1845

CHARLES ALLEN MUNN, President ORSON D. MUNN, Treasurer
ALLAN C. HOFFMAN, Secretary

EDITORIAL STAFF
J. BERNARD WALKER AUSTIN C. LESCARBOURA J. MALCOLM BIRD

DEPARTMENT EDITORS
ALBERT A. HOPKINS, Notes and Queries
ISMAR GINSBERG, Chemical Engineer.
VICTOR W. PAGE, Automotive Engineer.
HENRY NORRIS RUSSELL, Prof. of Astronomy, Princeton University.

CORRESPONDENTS
C. H. CLAUDY, Washington, D. C.
HECTOR C. BYWATER, London, England
ALFRED GRADENWITZ, Berlin, Germany
LEONARD W. MATTERS, Buenos Aires, Argentine Rep.

CORRESPONDING EDITORS
H. DIEDERICHS, Prof. of Experimental Engineering, Cornell University.
SAUL DUBHMAN, Ph.D., G. E. Research Laboratory.
EDWARD ELLERY, Consulting Chemist, Union College.
RALPH J. FOGG, Prof. of Civil Engineering, Lehigh University.
LEON A. HAUSMAN, Ph.D., Instr. in Protozoology and General Biology, Cornell Univ.
HARRY S. HOWER, Prof. of Physics, Carnegie Institute of Technology.
M. LUCKIESH, Dir. of Applied Science, Nela Research Laboratories.
ROY W. MINER, American Museum of Natural History.
H. F. MOORE, Research Prof. of Eng. Materials, Univ. of Illinois.
W. A. MURRILL, Ph.D., New York Botanical Garden.
W. C. PECKHAM, Prof. of Physics, Adelphi College.
H. C. RAMSOWER, Director of Agricul. Ext. Service, Ohio State University.
SAMUEL J. RECORD, Prof. of Forest Products, Yale University.
JOHN RITCHIE, Massachusetts Inst. of Technology.
J. HAMMOND SMITH, Prof. of Civil Engineering, Univ. of Pittsburgh.
EDWARD G. SPAULDING, Ph.D., LL.D., Prof. of Philosophy, Princeton University.
G. A. YOUNG, Head, Mechanical Engineering, Purdue University.

Vol. 126, No. 5. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.
Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

Caterpillars give 10,000 miles under 15 ton load

The big Selden truck pictured above is used by the Consumer's Hygienic Ice Co. of Union Hill, N. J., in hauling fuel oil to their plant from Bayonne, fifteen miles away.

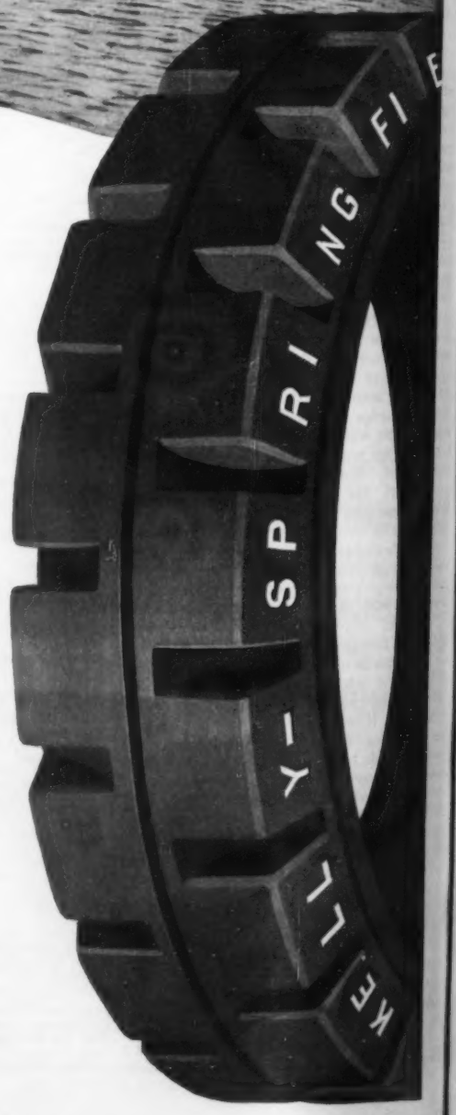
The capacity of the tank is 1725 gallons and the weight of the oil carried at each trip is about 8 tons. This added to the weight of the truck and tank makes the total weight resting on the tires about 15 tons.

Since the truck makes an average of three trips or ninety miles a day over what Mr. E. M. Hatch, chief engineer for the ice company describes as "very bad roads, full of big cobblestones and deep holes," it doesn't require much argument to prove that the tires are subjected to severe use.

The first Caterpillars that were placed on the rear of this truck were 40 x 12—too small for the overload which they had to carry—yet they gave over 10,000 miles under the conditions described.

This record speaks well for the ability of Caterpillars to withstand severe punishment and the fact that the truck has been able to make its regular number of trips daily in all kinds of weather is a splendid testimonial to their traction qualities.

Caterpillars are made in sizes suitable for trucks of every type and weight



KELLY-SPRINGFIELD TIRE CO.

GENERAL SALES DEPARTMENT 250 WEST 57th ST., NEW YORK

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MAY, 1922

Where the Money Goes

How Uncle Sam Will Spend His Income for 1922

FOR the fiscal year 1920, as we showed in a chart published in our issue of December 25th of that year, the expenditure by the United States Government in connection with the closing out of past wars was 67.8 per cent of Uncle Sam's annual budget, while the Army and Navy maintenance costs, which are included under the heading of national defense and preparation for possible wars of the future, swallowed up 25 per cent in addition, leaving but 7.2 per cent of the national income available for all the other functions of government.

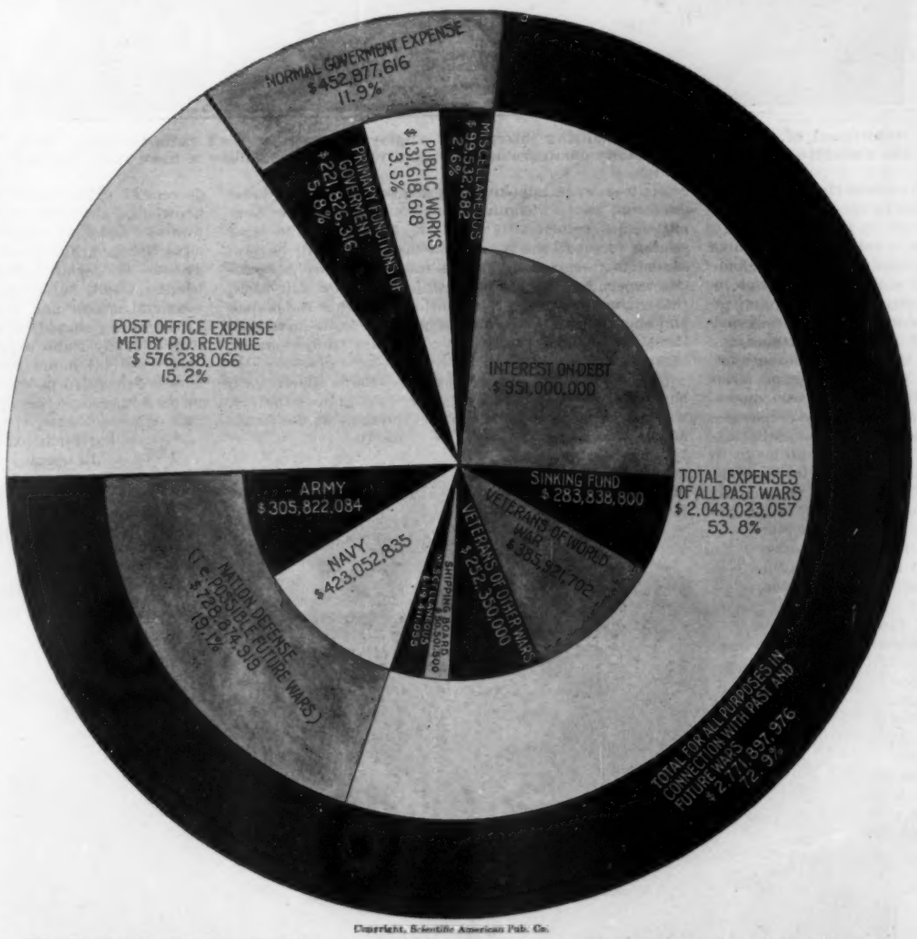
That the pruning knife placed in the hands of General Dawes and wielded also by Congress itself has not been without effect is seen when we compare the showing of the fiscal year 1922, as forecast in the budget for the year, with the figures quoted above. The wars that we have left behind us cost us now only 53.8 per cent of the year's income; the specter of future wars is to be kept down for the present year's purposes by a salve consisting of only 19.1 per cent of the year's funds; and no less than 27.1 per cent of the nation's income is to be devoted to the regular work of the Government outside the naval and military.

Specific comparison of the items in the present list with those of two years ago shows that a large part of the improvement is due to the elimination of a huge railroad operating loss from the Government's liabilities, and to the fact that Uncle Sam's venture into the shipping field is not carrying nearly so heavy a current expense as it did in 1920. The care of veterans of the World War is costing us more, and pensions paid to veterans of previous wars and their families are about stationary, due to the Congressional habit of raising the rate to keep pace with the diminution in the pension roll due to death.

In the chart herewith we have divided the governmental expenditures into three major groups—the one that has to do with past and present wars and the possibility of wars, the expense of the post office which in theory and to a very large degree in practice as well is met by direct charges against those who avail themselves of the postal facilities, and the other ordinary governmental expenses which represent a charge against the people at large for service rendered them at large. Under the first two heads the chart is sufficiently specific, and leaves no questions unanswered. Under the third, it is otherwise; classification must go much deeper than the chart can take it to give us a clear idea of where this particular portion of the money goes.

During 1922 there will be $105,000,000 of Federal funds spent on good roads—and nobody will begrudge this sum. Aside from the good roads program, the Department of Agriculture will take $48,000,000 out of Uncle Sam's pocket, the entire sum being expended for what we may recognize as research and education and information, plus the necessary administrative expenses over these. The Interior Department will get $34,000,000. Administration of the District of Columbia will cost $24,000,000; the Department of Commerce will get $20,000,000; and in the other branches of the executive, lesser sums will be expended. When we seek to isolate from the rest the specific items which go to research and direct service to the people, we find that the amounts are surprisingly small. The Bureau of Standards must get along on a million and a half; the Bureau of Foreign and Domestic Commerce a little less; the Bureau of Fisheries about the same; the Census Bureau twice as much. The Weather Bureau has $1,500,000; the Bureau of Animal Industry, $8,000,000; the Bureau of Plant Industry about two and one-quarter millions; the Forest Service, $7,500,000; the Bureau of Entomology, $1,400,000; the Bureau of Agricultural Economics, $2,500,000. So, while appreciating the improvement over the specific showing of past years, it is still possible to express regret that scientific research and the dissemination of information are allotted such meager sums in comparison with the expenditures for purposes which even their proponents must admit are less useful. It is by scientific discoveries that our arts, our industries, our business activities are improved and made more efficient. The protection of public health, the eradication of disease, the extension of education, the discovery and development of new industries based upon new scientific facts, are among the assets which accrue to the public from the investigations of scientific men. The achievement of the present Congress in making so striking an improvement over the showing of two years ago is in no way aspersed when we point out the utter inadequacy of the sums that traditionally have been and that still are being spent in governmental support of scientific research. We should be able to afford to make this the best financed of Uncle Sam's activities, rather than the worst.

It is to be borne in mind that in the nature of the case the figures shown in this chart are but tentative. Many of them will be modified by further attention to advance estimates, and in operation during the year economies and unexpected additional expenses will, of course, develop. But the present condition of the budget gives substantially accurate information regarding the relationship between the expenditures of the various classes. The only possibility of serious revision of the ratio between the several classes of expenditure shown by the chart is the very remote one that a bonus plan may be adopted calling for heavy expenditure at once.



The distribution of Uncle Sam's income for 1922, showing the various purposes for which it is used

Taking the Riddles Out of Radio

Solving at the Washington Conference the Perplexities That Complicated Wireless Communication

By George H. Dacy

BECAUSE the infant radio industry has outgrown its swaddling clothes with a speed as great as that of the mythical beanstalk that Jack grew, the most important conference in the history of American radiography—called by Secretary of Commerce Hoover at the behest of President Harding—was convened recently at Washington and has laid the foundation for correcting the defects which jeopardize our most novel method of communication. One year ago the problems of the radio telephone and telegraph were relatively few and simple. There then were but 50,000 wireless telephone receiving sets in use in this country. At present, there are more than 600,000 receiving sets in use—some authorities place the total at 1,000,000 or more. The comparative cheapness of these equipments and the fact that the American boy takes to them with the same avidity that he accepts long trousers, indicate that in the near future apparatus of this type will be a fixture in practically every progressive American home.

Copyright, Kadel & Herbert

Assortment of receiving and transmitting instruments employed by a New York radio amateur. Note the elaborate apparatus used. Many amateurs have invested thousands of dollars in their radio stations

The use of the ether—the name given to the medium through which radio waves travel—is not limitless. It will accommodate just so many wireless messages and no more. When this limit is exceeded, chaotic conglomerations of sounds, which rival the busy day noises in a boiler factory, prohibit the sending or receiving of any kind of messages. Because ether chaos threatened our radio industry, the conclave of radio experts assembled at Washington. Despite that, the conference at this writing is still wrestling with the enigmas associated with remedying the errors of our radio operations, the consensus of opinion among the experts—these views will probably be the basis for potential legislation by Congress—is that (1) complete authority to control radio in the United States should be vested in the Secretary of Commerce, (2) that the radio apparatus used throughout the country should be of the types most effective in reducing interference (that is, eliminate the use of inferior and defective sending and receiving sets), (3) that wave lengths be properly allocated to coincide with the present status of the industry.

The initial sessions of the Radio Conference consisted of open meetings to which every branch of the radio industry was invited in order to make suggestions, to offer criticisms or to point out the advantages of certain systems and methods. Thereafter a special committee of which Dr. W. S. Stratton, director of the Bureau of Standards, is chairman, was created. The other members are Major-General G. O. Squier, Chief Signal Officer of the U. S. Army; Captain S. W. Bryant of the U. S. Navy; J. C. Edgerton, superintendent of the radio service of the Post Office Department; W. A. Wheeler, U. S. Department of Agriculture; Representative W. H. White, Jr., of Maine; R. B. Howell, Omaha, Nebraska, post office expert who recently has returned from an investigation trip of the European radio industry; Dr. A. M. Goldsmith, secretary of the Institute of Radio Engineers; H. P. Maxim, president of the American Radio Relay League of Hartford, Conn.; Professor A. L. Hazeltine, Stevens Institute of Technology; D. B. Carson, Commissioner of Navigation, Department of Commerce; Professor C. M. Jamsky, University of Minnesota, and E. H. Armstrong, Columbia University. The members of this committee were appointed to discuss the accumulated data and make definite recommendations. The committee has referred its tentative findings to the legal section to draft the new radio law which will be presented to Congress by Representative White. A tentative report has been adopted which has been sent to all the original representatives to the conference for review and suggestions. After all the points at issue have been thrashed out in this way, the conference will reconvene to make whatever advisable changes are necessary.

Unquestionably, the new regime which shortly will begin the revolutionizing of America's radio situation, will centralize the control of the industry in the hands of the Government. Recently, the Secretary of Commerce has been hindered in his administration of the laws of radio enterprise because they were enacted in 1912 and have never yet been revised to correspond to the remarkable developments which have been made since that period. All agencies represented at the Conference were unqualifiedly in favor of regulations for the radio industry, but they felt that these rules should be made of rubber to the extent that they could be changed and stretched to cover future exigencies which may developed in an art that is so young.

Secretary Hoover throughout the conference championed the cause of the American boy. He emphasized the need for protecting the interests of the amateurs. He also was desirous that regulations be developed which would permit of Uncle Sam handling the administration of the reinforced radio laws which soon will be passed by Congress for the best interests of the radio industry. One of the fundamental achievements of the conference in executive session will be the allocation of wave lengths. Another probably will be the regulation of broadcasting. Such suggestions have been made as that the amateur wavelength band of 150 to 250 meters should be expanded upward as the amateur's tendency toward interference decreases. This would benefit the small boy as his knowledge about his radio set increases. Proposition was also made to confine the broadcasting of concerts, advertising, athletic contests, sermons, and other addresses to certain other bands, while higher wave lengths would be set aside for the official government communications and for ship-to-shore messages. The broadcasting should be classified according to the findings of many radio experts so as to eliminate interference. Special hours for broadcasting will also doubtless be scheduled potentially with all business and commercial messages being handled during the daytime, and entertainments, concerts and other musicals holding forth exclusively at night.

In opening the Radio Conference, Secretary Hoover said: "This conference is called at the request of the President, and its purpose is to inquire into the critical situation that has arisen through the astonishing development of the wireless telephone. Its purpose is to advise the Department of Commerce as to the application of its present powers of regulation and to develop the situation generally with a view to recommending to Congress, if it be necessary, to extend the present powers of regulation. This is one of the few instances that I know of in the country where the public—all of the people interested—are unanimously for the extension of regulatory powers on the part of the Government. In undertaking the organization of the conference, we have considered that it was desirable to draw the Committee that is to give consideration to the results of the conference largely from technical men representing the different government departments and sciences."

There are more than ten million telephone subscribers in this country. If they substituted radio telephones for the ordinary phone in their daily conversations, the ether would be rendered useless so far as the wireless commu-

Copyright, Keystone View Co.

Typical radiophone transmitter, such as is used in various parts of the country for broadcasting purposes. It is the relatively low cost of such equipment that has caused so many small broadcasting stations to spring up and cause undue interference.

nication was concerned. Under proper restrictions, the wireless telephone has a definite field. It is adapted to the distribution of certain pre-determined material of public interest from central stations. This material must be limited to news, educational affairs, entertainment and communications about such commercial matters as are of importance to large groups in the community. Wireless should not be used for communication purposes which could be served satisfactorily by other agencies such as the telephone or telegraph. The only radio laws which have been administered consist of the issuance of radio licenses by Secretary of Commerce to radio sending stations subject to certain conditions designed to prevent interference between the stations and to serve the public good.

Up until the last six months, little difficulty was evident in the transmission and reception of radio messages. The sending previously had been confined largely to the radio telegraph. The recent extensive use of radio telephone has completely changed conditions and has necessitated the regulation of the use of the ether. Most licenses have been issued to government broadcasting agencies and to American amateurs. Rules are needed to prevent interference between the sending stations by the proper arrangement of wave lengths. It is possible to increase the number of sending stations and thus the volume of material distributed if the power applied to certain wave lengths is limited so as to circumscribe the area of distribution from a given station. Certain times of day may be set aside within certain wave lengths for the sending of certain types of information. Thus, a receiving set owner might tune his instrument to different wave lengths to receive a wide range of information. Universities, technical schools and governmental offices all are willing to distribute valuable information. Merchants are anxious to install sending sets and to disseminate such data if they also are permitted to use the outfits for advertising purposes. Newspapers desire sending sets and licenses to broadcast news and entertainment and to undertake commercial broadcasting of one kind or another.

Representatives of one of the leading communication systems reported to the conference that their organization operated the only commercial radio telephone line in the country today. It connects Catalina Island and the California mainland. This system, known as the radio link, was described in our November, 1921, issue. Practically none of the subscribers to this service know that it is wireless as they get their numbers from a telephone book and call the central operator for connections. This operator switches them from regular telephone service to radio telephone when they ask for Catalina. Just to show the wide distance over which radio telephone messages may be transmitted even when they are of short wave length, it is worthy of note that the British Navy reports that one of its ships picked up a message off the coast of Australia which had been sent from Los Angeles and destined for Catalina.

There is one county in the United States located in the Kentucky mountains which has neither telegraph nor telephone facilities while it also lacks both post road and railroad. It would cost over $100,000 to equip this section with a telephone line about 40 miles long. A public radio telephone service could be established at a much lower cost. In sections where topographical features or other disadvantages prohibit the use of the regular telephone, the wireless telephone offers commercial possibilities. For the use of the U. S. Forest Service it is of value in forests where wire lines cannot be installed or where the fire hazards which might cause the downfall of a pole line are excessive.

Copyright, Keystone View Co.

Virtually any sound can be transmitted by the radiophone. In this instance the radiophone broadcasting station is transmitting music obtained by rubbing drinking glasses

Representative White of Maine is a staunch advocate of radio regulation. He maintains that the type of material broadcasted should be regulated. Crop reports and weather predictions are much more valuable than theater advertisements. He also contends that certain wave lengths should be allotted to telegraph and telephone companies for emergency uses. The commercialization of public radio service will soon be tried out experimentally in New York City, where the first public broadcasting station will be operated. It is a step toward the standardization of radio broadcasting and may result in the reduction of the indiscriminate use of the ether which recently has been objectionable.

The development of the public radio telephone pay stations means that certain wave lengths will have to be granted to the public corporations to render this scheme successful. The communication system that has fostered the initial public pay station reports that it was beseiged by private firms that desired to purchase radio sending sets so that they could use the ether commercially. The communication system decided that the best way to solve this demand was to establish public pay stations. Early experiments indicate that messages of short wave length which were hard to pick up by faulty receiving sets 20 miles from New York traveled as far as 1000 miles from land off the Pacific Coast, where they were picked up by oil tankers.

Representative White contends that the allocation of certain wave lengths to reputable communications companies which will operate them for commercial purposes under strict regulation by Uncle Sam is one of the sensible ways to solve the ether enigmas which have complicated radiography. He purposes to introduce a radio control bill into Congress based on the findings of the radio conference. He advocates the delegation of authority to the Department of Commerce to exercise complete control of the radio telephony in this country and the right to classify stations as transcontinental, transoceanic, ship-to-shore, amateur and the like. Certain wave lengths should be assigned to each station. Portions of the day should be reserved for the transmission of certain kinds of information. Limitations should be put on the use of certain wave lengths. Control should be lodged in a civil rather than a military branch of the Government because this communication medium is the right bower of domestic and international commerce.

Interesting statistics were presented to the conference by representatives of one of the leading makers of radio sets and equipment. According to these figures, it would cost commercial concerns approximately $15,000 to install and $25,000 a year to operate a broadcasting equipment, not figuring on the easements or rentals, the cost of musical instruments and the services of artists. It would cost between $750,000 and $1,000,000 to put 10 broadcasting stations in operation in different sections of the country. This same expert said that his company could market 60,000 vacuum or electron tubes a month—the demand is so great—if they made that many. He announced that his concern was selling radio sets at the rate of $50,000,000 worth a year. One morning recently this firm received 600 telegrams ordering radio sets in the course of the forenoon.

The radio telephone is a particular boon to the American farmer. It supplies him with daily market reports and weather forecasts, in addition to providing him with entertainment in the form of music, lectures or sermons after the day's work is completed. "Farm Radio Clubs" made up of rural boys and girls interested in the radio telephone are being organized in all sections of the country by the Department of Agriculture. There are more than 32,000,000 farmers and their families in the United States that are relatively isolated from the leading news centers. The radio telephone eliminates this isolation. Through the Post Office Department, Uncle Sam daily sends out reports on the live stock, grain, vegetable, fruit, hay and cotton markets, so that any farmer in the country equipped with a receiving set may get this information. State farm bureaus and agricultural col-

(Continued on page 364)

Copyright, Keystone View Co.

A radiophone broadcasting station sending out the voice of a child singer, accompanied by a piano and banjo. Note how the microphones provided with horns, have to be placed in order to catch the desired sound waves

Our Wasteful Industries

Six Major Manufacturing Groups That Make a Bad Showing as Regards Operating Efficiency

By Robert G. Skerrett

AMERICA is coming to a realization of the measure of her industrial waste. At least, this is true of a leavening group of our technicists and some of the executives responsible for the management of a goodly number of our big enterprises. On the other hand, it is doubtful if more than a modest part of the public is conscious of the conditions in productive effort which are imposing a heavy burden annually upon the people at large. This negligence or indifference entails ineffectual outlays each twelvemonth totalling billions of dollars.

This arraignment of our methods or lack of them, as the case may be, would be disheartening if remedies were not at hand. It is practicable for us to apply these corrective agencies and thus to achieve tremendous economies and to bring down prices proportionately. Not only that, but certain of these changes in practice or procedure would hasten the day of keener cooperation and more sympathetic understanding between the worker and the man who employs him.

Much of the material contained in this article is drawn from the report of the Committee on Elimination of Waste in Industry. This body was organized by the Federated American Engineering Societies in January of 1921, and was inspired by Mr. Herbert Hoover. During a period of five months, the committee made an intensive study of waste in six of our important industries: men's clothing, boots and shoes, textiles, printing, building, and the metal trades. The purpose of the committee is to make similar assays of other branches of our industrial life. In the meantime their revelations furnish ample food for thought, inasmuch as some of the defects or shortcomings discovered are general, and in no sense peculiar to any of the businesses studied.

All of us must have a roof for shelter, and the price of ownership or the amount of the rental depends upon the cost of construction and upkeep. Further, the ultimate consumer has to pay for the buildings that house industries or any other activities that contribute in one way or another to his needs, his comforts, his conveniences or his pleasures. The building industry two years ago required 3,000,000 mechanics and laborers, about 7 per cent of the nation's total of persons engaged in gainful occupations. The labor of these men increases the country's wealth annually by more than $3,000,000; and yet the material returns fall far short of what they could and should be.

There are three primary causes of waste in building operations: irregular employment of the workmen, inefficient management by those in charge, and the hampering regulations imposed by labor organizations. Then there are secondary wastes, which are attributable to customs or conditions prevalent in the industry; and to these may be added the use of poorly-designed equipment which not infrequently retards construction and invites the sacrifice of materials. Finally, there is the price paid for accidents which are mainly preventable.

In their analyses of the several industries investigated, the committee assumed a theoretical aggregate of 100 "points" as representative of the maximum possible waste; and the observed waste was then apportioned to the accountability of the management, the worker and the outside contacts. In the case of the building industry, taking it by and large, the experts registered 53 points against it, and responsibility was ascribed as follows: management, 34.3 points; labor, 11.3 points, and outside contacts, *i. e.*, the public, trade relationships, etc., 7.4 points.

The deficiencies of management are greater than most of us would imagine, and by reason of them there is wastage of time, material, and labor in many directions. All too often there is a lack of forethought in planning for the execution of a job; little attention is devoted to progress schedules which insure a proper flow of materials so that there will always be enough on hand to meet requirements; the cost-keeping methods relied upon by most contractors are inadequate; and the average builder gives only superficial heed to the amount, type, and location of equipment which may play a prime part in cheapening and in speeding up performances.

Again, contractors in this field rarely have an employment service that deserves the name; and it is only occasionally that the men in this business have preference lists based upon an intimate knowledge of the capability of the individual worker. These shortcomings, sooner or later, add heavily to the bill; while efficient management can raise the earnings of all concerned and lessen the while the expenses incident to a properly executed undertaking.

As matters stand today, workmen in the building industry are busy, as a rule, only two-thirds of their time in the course of a year; and their expectation is a wage for that period sufficient to maintain them the entire twelvemonth. In other words, the owners of buildings are compelled to pay 33 1-3 per cent more for the item of labor than would be needful if the men, for the same annual reward, were kept engaged the year through. Progressive contractors are finding ways to reduce seasonal unemployment either by protecting the men on the job in cold and inclement weather or by so arranging their activities that there will be something to do all the while. The gains in accomplishment and the potential savings by the common adoption of this procedure cannot be stated in exact figures; but from the evidence at hand it is plain that the benefits would be momentous. It is authoritatively estimated that construction labor costs can be cut 3 per cent by the institution of appropriate safety measures, and that from 75 to 80 per cent of the loss and waste due to accidents can be prevented.

And now we come to the sources of some of our wearing apparel. The manufacture of men's clothing calls for the services of 1,000,000 persons; and two years ago the 5254 establishments in the business had an output valued at $1,158,006,904. Owing to the seasonal nature of the demand for garments, the investigators discovered that the average plant utilization over a three-year interval of eight big representative factories did not exceed 69 per cent of a possible maximum. During a twelvemonth, this intermittent productiveness on the part of the operative is equivalent to nine hours of idleness in every working week. We are told that at least ten hours more count for naught by reason of energy-wasting and time-wasting shop methods, while another two or three hours are lost weekly through unnecessary labor.

In the slack periods a goodly number of the large concerns run at only 20 per cent of their capacity, while many of the small ones are closed. It is probably conservative to say that the great bulk of the shops could get along with 50 per cent of their existing plant capacities if they were operated at a uniform rate from one end of the year to the other. This would also obviate laying off the hands for 31 per cent of the time annually; would make for content and stabilize labor conditions; and would lower the cost of the garments turned out.

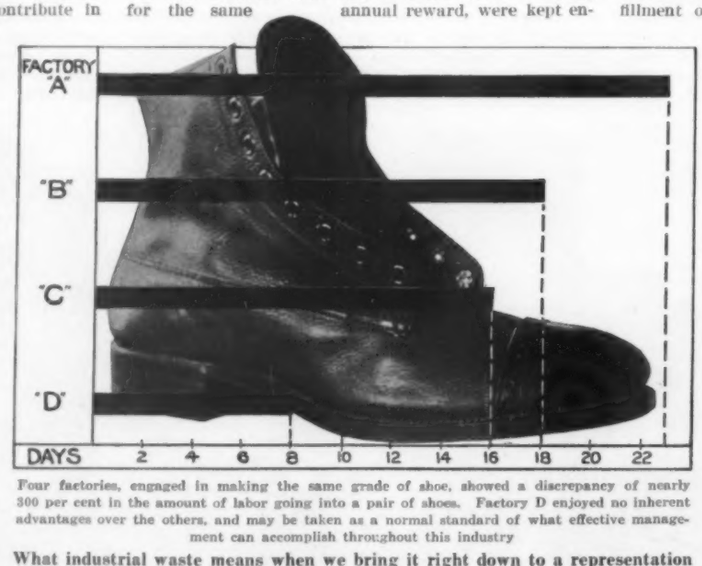
The usual practice in the trade is to make goods only after the receipt of orders—in other words, to respond to a "bunching" of demands at certain seasons; and heretofore the manufacturer has been required to make up many different models, in various sizes, in lots of from two to twenty. Not only that, but to attract trade the producer has allowed his customer to choose materials from numerous patterns. Even so, an order is at present not necessarily a sale. All too often, purchasers who buy on long-time credit either cancel the order while in the process of fulfillment or they return unsold garments when they are no longer marketable, and expect credit therefor. The maker must look for a buyer elsewhere; and he saves himself from loss on this deal by adding proportionately to the price of other lots of goods. The citizen who wears ready-made clothes pays for the wastefulness and the lax methods of the industry.

The engineering experts are convinced that the whole business can be materially bettered by limiting the number of models and the styles of cloth; by manufacturing for stock so as to bridge over dull seasons; and by standardizing machinery and having in reserve sufficient apparatus to maintain all operating equipment at a maximum stage of efficiency. The investigators are of the opinion that the men's ready-made clothing industry can readily be brought to a state where it will be feasible to effect an aggregate daily saving of more than $750,000! According to the survey, the industry is charged with 63.78 points of waste, which are apportioned as follows: management, 48.33; labor, 10.5; and outside contacts, 4.95. Of the six businesses reported upon, this one was found to be the least efficient.

The boot and shoe industry represents a capital investment of $500,000,000; it is made up of 1300 companies; employs 225,000 persons; and turned out last year commodities to the value of $1,300,000,000. In the course of the twelvemonth, the factories fabricated 300,000,000 pairs of boots and shoes, and the earnings totaled $280,000,000—a profit on an average of 90 cents per pair.

Like that branch of the ready-made clothing industry just considered, the boot and shoe industry is subjected to intense seasonal demands, with intervening periods of greatly reduced activity. The shoe plants of the country have a capacity of about 1,750,000 pairs a day, and yet the average output is only 977,000 pairs on the basis of a 300-day working year. As a matter

> *TAXATION experience of the past decade ought to make it clear, even to him who dodges unwelcome conclusions, that it is the ultimate consumer who pays the bills, whatever their nature. No producer can go on producing at a loss; whatever he spends, either in actual production or as an incidental thereto, he must get back from his customers; and they from theirs; and so on, down the line, until we come to the man who buys, not for resale, but for his own use. Like the rabbit in the Congress of Animals, he has no one beneath him to whom he may "pass it." And so it is that industrial waste is of interest to all of us; for in direct measure with its prevalence we all pay more for what we eat and wear and use. Mr. Skerrett tells here the story of recent investigations, which indicate that the sum total of preventable waste in our industries is much larger than we should have imagined.*—THE EDITOR.



Four factories, engaged in making the same grade of shoe, showed a discrepancy of nearly 300 per cent in the amount of labor going into a pair of shoes. Factory D enjoyed no inherent advantages over the others, and may be taken as a normal standard of what effective management can accomplish throughout this industry

What industrial waste means when we bring it right down to a representation in terms of the finished product

of fact, however, the operatives do not work 300 days a year. The manufacturers estimate that the average shoemaker is engaged at most 65 per cent of his possible productive hours, and this means 35 per cent or more of idleness annually. The wage paid is therefore set high in order to neutralize the weeks when nothing is earned.

The problems of the industry are increased by the vagaries of style. As it has been expressed: "Millinery in footwear is outstripping millinery in hats"; and sales records show that for every pair of shoes bought by a man a woman will get four pairs. It is not hard to grasp that multiplicity of sizes and varieties of kinds add heavily to the aggregate cost of output and to wastage. Substantial economies could be effected by putting out fewer novel styles, and by distributing the making of staple patterns throughout the year. Scientific management has a chance to do much in the boot and shoe industry. It is computed that the fluctuation of seasonal demands, and the losses of time due to unbalanced production of associate departments cause the item of labor on a pair of shoes to be nearly double the possible minimum. In other words, wasted time now occasions annually a sacrifice of $65,000,000. How much room there is for improvement in the boot and shoe industry can be gathered from the fact that the investigators charged it with 40.93 points of wastage; management, 30.25; labor, 4.85; and outside contacts, 5.83.

The textile industry in the United States is said to rank second only to the iron and steel industry in the amount of money involved, and the invested capital products of many sorts; shipbuilding and ship repairs; electrical commodities of divers kinds; and firearms and ammunition. The experts declare that the average metal-working establishment is 25 to 30 per cent behind the best plant in output per employee. What can be accomplished in the way of eliminating waste by improved management is typified by a factory where 1175 operatives turned out 22,000 units in a week and where, a year later, performance was raised to 34,000 units per week by a force of only 800!

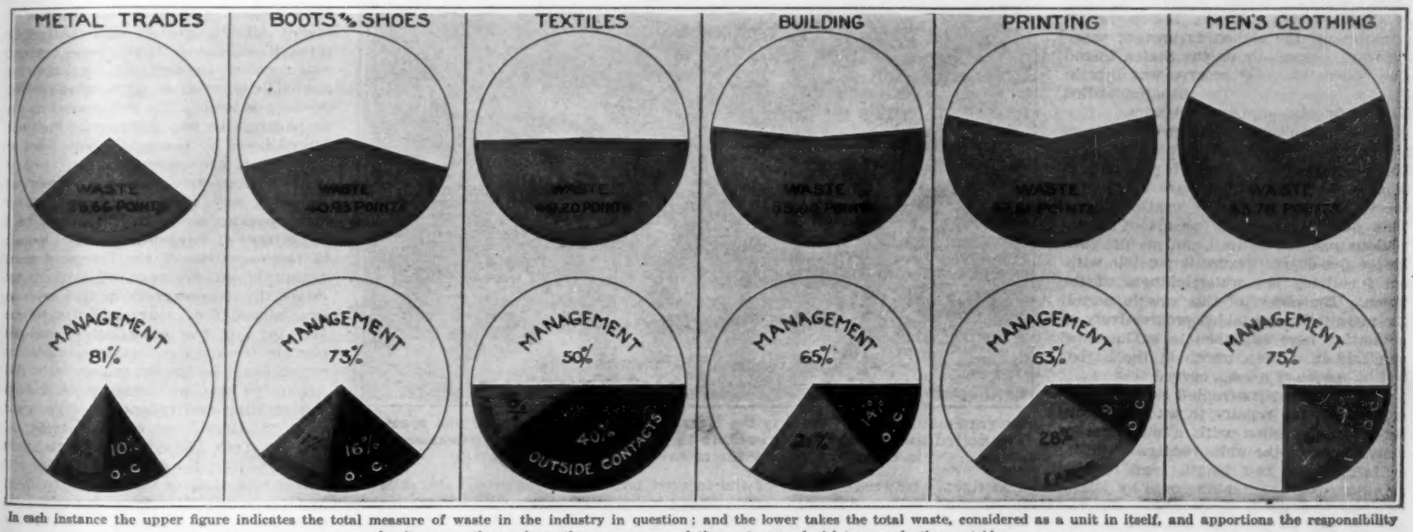
The metal trades have scored against them an aggregate of 28.66 points of waste—*i. e.*, management, 23.23; labor, 2.55; and outside contacts, 2.88. In brief, management is accountable for 81 per cent of the losses attributable to non-production.

Printing in one form or another touches us at well-nigh every turn, and few of us are conscious of what we pay for this appeal to the imagination and reasoning faculties. The printing industry involves a total investment of substantially $1,500,000,000, and the output in 1919 was valued at more than $3,000,000,000. The business embraces among other activities the manufacture of printing machinery, printing ink, paper for printing, and type founding. The scope of the investigation, however, was limited to book, job, and periodical printing. The United Typothetae of America estimates that the printing industry is over-equipped anywhere from 50 to 150 per cent, which means that there are hundreds of millions of dollars tied up in idle apparatus, etc. And it seems that there is a fluctuation of 50 per cent in the number of employees engaged at different seasons of the year in

assume an average wage of $4 per calendar day ($28 per week) the above time lost represents a wage loss of $1,184,000,000. From this we may subtract the actual cost of subsistence of the men killed, which may be placed at approximately 60 per cent of their wages, or about $331,000,000. This leaves a net economic loss to the country of about $853,000,000 for the year 1919." There might seem to be an inaccuracy here, since 60 per cent of 1184 is not 331. The former figure refers to men both killed and injured, however, while the latter includes the living cost only of those actually killed. Eminent authorities are agreed that it is entirely practicable, by adopting methods already tried out, to reduce deaths and serious accidents—and therefore to lessen accident cost—in American industry by at least 75 per cent.

The general death rate among industrial workers, ranging in ages from 15 to 65, was estimated in 1920 to be 11.46 per 1000 living. With a population of 42,000,000 gainfully employed this would be equivalent to a vital sacrifice of 481,300. By systematic medical inspection it would undoubtedly be possible to greatly diminish this mortality. Eye conservation, through preventive or protective agencies, has made long strides forward; and in many establishments these precautions have cut down eye accidents anywhere from 50 to 85 per cent.

One of the most suggestive aspects of this subject is the steps that have been taken by some concerns to correct substandardized vision. By the fitting of proper glasses, the operatives in one plant, where fine work was done, improved their productivity fully 28



In each instance the upper figure indicates the total measure of waste in the industry in question; and the lower takes the total waste, considered as a unit in itself, and apportions the responsibility for it among the workers, the managers, and the customers, legislators, and other outsiders

A graphic arraignment of wastefulness in six of America's greatest industries

is conservatively put at $3,500,000,000. In 1920 the value of its products was about $7,000,000,000, and all but $500,000,000 worth of the commodities were used at home. The industry comprises the manufacture of fabrics for wearing apparel, of carpets, of draperies, of blankets, of sheetings, and of numerous other woven, knitted, and felted materials. There are 12,964 plants in the business. The general status of the industry, gaged by a possible maximum of efficiency, falls much below the attainable standard; and the average of waste is put at 49.2 points, the responsibility for which is as follows: management, 24.7; labor, 4.7; and outside contacts, 19.8. On the face of it, the industry has still to cut down its wastage by nearly 50 per cent. Supposing that 20 per cent of the manufacturing cost be due to preventable waste, then the ultimate consumers are paying every year $1,400,000,000 more for these goods than they should.

The metal trades industry, as a whole, is the largest of our manufacturing activities in the value of its output. The working army totals 2,000,000; and it is entirely practicable through increased production to swell the returns annually by over half a billion dollars. At the present time, due mainly to extensive unemployment of available men and machinery, the waste is close to $1,000,000,000 in the same interval.

The metal-making branch of the business has not been included in the survey. This has been confined to those divisions which fabricate raw materials, so to speak, and have to do with machinery and machine tools; automobiles, trucks, and tractors; engines, locomotives, cars and trucks; machine shop and foundry the more pretentious printing and binding establishments.

The survey rates this business as wasteful to the measure of 57.61 points and divides the inefficiency in this manner: management, 36.36; labor, 16.25; and outside contacts, 5. Faulty management must answer for 63 per cent of the factors that make for waste; and in this industry, as in the cases of the five others analyzed, a lack of proper administration is the predominant weakness. The standardization of machinery, of paper, of inks, of colors, and of columns, pages, and sheets would effect enormous economies. It has been stated that the standardization of newspapers to one size would make possible an annual saving of from three to five million dollars in the charges for composition and plates alone. Taking into account the diversity of dimensions among current magazines, trade publications, etc., we are told that these variations, "which accomplish absolutely nothing," either directly or indirectly, tax the public's purse to the extent of not less than $100,000,000 each year. Out of a total of 1538 plants only 56 had a cost system; and 1295 of them lost money in 1919.

In conclusion, let us dwell briefly upon the losses incident to industrial accidents and to the impaired health or physical deficiencies of the workers. According to the latest figures available, those for 1919, there were, during that twelvemonth, 23,000 total fatal accidents; about 575,000 non-fatal accidents causing disability for four or more weeks; and something like 3,000,000 accidents which laid the employees off for at least a day. To quote the report of the Committee on Elimination of Waste in Industry: "If we may

per cent in the course of a couple of months. A firm engaged in the manufacture of paper boxes had the eyes of its 3000 hands examined, with the following results: 22 per cent were found to be normal; 38 per cent were astigmatic; 28 per cent were hyperopic; 7 per cent were myopic; and 5 per cent were color blind. This gives some idea of the prevalence of substandard vision—a deficiency which may bear directly upon the quality of workmanship, the waste of materials, and even the well-being or safety of the personnel. Again, vision is often hampered by the conditions of lighting, and improved illumination soon pays for itself and makes for a better and fuller output.

No small part of industrial waste is the consequence of labor's lack of interest in repetitive or monotonous tasks, which are important because of the quantities involved or for various other reasons. There is a growing tendency to introduce factors of a competitive nature which will lend color to comparative drudgery and thus stimulate initiative, resourcefulness, and even the creative faculties. One way of achieving this is to chart progress in eliminating waste of material—success in this being proof of a gain in knowledge and skill. The response, where this has been tried, has been extremely encouraging. A single instance will serve to illustrate the benefits: in a pulp mill, the yearly production was raised from 42,000 tons to 111,000 tons without adding to the number of digesters for cooking the pulp, or without amplifying the wet machines for handling the finished product; and the ultimate commodity was changed from one of poor quality to the very best grade.

Cutting and Fitting Beneath the Waves

The Under-Water Torch Speeds Up a Difficult Repair Job on the Narrows Siphon

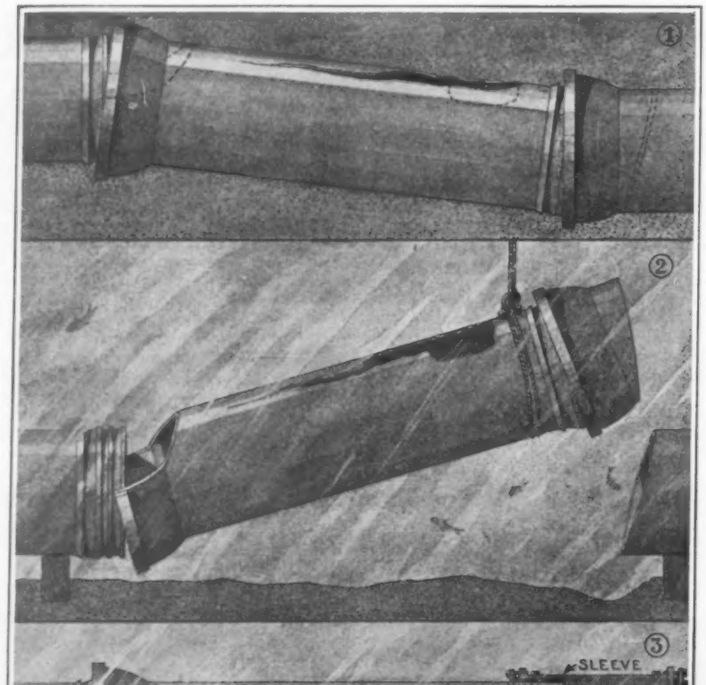
By Ralph Howard

FULLY 125,000 people of the Borough of Richmond of the City of New York are commonly dependent for their daily supply of water upon a large cast-iron conduit, 10,000 feet long, which is laid in the bed of The Narrows, a navigable route between Staten Island and the Borough of Brooklyn. This main is joined with the Catskill water supply system on the Brooklyn side of the harbor and discharges ultimately into Silver Lake reservoir of the Borough of Richmond.

While engaged in deepening the slip adjacent to the northernmost of the new municipal piers, lately finished along the Staten Island waterfront, a dredge inadvertently dropped one of its big spuds on to the conduit close to the inner bulkhead line and smashed a large piece out of one of the pipe-sections. At that point the top of the main lies 50 feet below the harbor's surface and under an overburden of 23 feet of mud—much of which is of the consistency of silt. The damage necessitated the speedy closure of the gate valves at the Brooklyn and the Staten Island terminals of the siphon to prevent wasting water, especially on the Staten Island side, where the only reserve was that in the local reservoir. The situation called for prompt and permanent repairs.

The conduit was constructed six years ago and by a method then novel. Each 12-foot length of the 36-inch pipe carries at one end a bell-shaped flare into which the spigot end of the next length is fitted. This joint is sealed by means of an ingenious packing of lead, and so designed that a five-degree flexure is possible without impairing the watertightness of the union. The object of this was to permit the main to be assembled progressively on a floating base and then to be launched and laid in a deep trench in the harbor bed by means of a long, curved skidway.

The task that confronted the engineers engaged on the repair job was to remove the injured section with a minimum of disturbance of the units contiguous to it; to interpose a new length; and to bind this link with the flanking ones by joints quite as tight as those previously made above water. Haste was a factor. The undertaking was brought within the realm of the possible by the development, in the last four years, of an efficient submarine metal-cutting torch, now patented.



Diagrammatic story of the way the Narrows siphon was damaged and repaired. The dotted lines in drawing 1 indicate the sections cut by the submarine torch in order to facilitate the removal of the injured piping

To appreciate the part played by the torch, let us understand the nature of the break, the associate conditions, and the work that had to be done to effect the withdrawal of the ruptured pipe. While the fracture was wide and long it was not big enough to permit a diver to get inside of the conduit to bring the torch into action at a point which could not be reached in a satisfactory manner from without. Therefore the first step, after alining and blocking up the contiguous sections which had been depressed by the shattering blow, was to enlarge the breach. To achieve this, the torch had to burn or cut its way through the 1⅝-inch shell of the parallel body of the pipe.

The overlapping bell of a joining length was next severed from its own parallel body by cutting the lower third of its circumference from inside the pipe and the remaining two-thirds from the exterior. This vertical cut was on a slant which was so directed as to facilitate lifting that end of the detached section. In order to break the solidly-packed joint between the bell of the injured unit and the inserted spigot of the pipe-length ahead, a way had to be devised to accomplish this with a minimum of wracking force. It was therefore decided to cut away with torches a goodly sector of the bell top for the purpose of permitting an elbow-like movement when raising the opposite end. When the lifting was begun, however, the bell detached itself at once without shock. But before the heaviest part of the bell could be cut through, the divers had to remove a portion of an enveloping wrought-iron band 4 inches wide and 1½ inches thick. This called for two cuts, and the work was done in a single day by one diver. The cast-iron bell-mouth was 3½ inches thick through, and proved very difficult cutting. The 1⅝-inch walls were cut at the rate of from 4 to 6 inches an hour, depending upon the ease with which the points of attack could be reached.

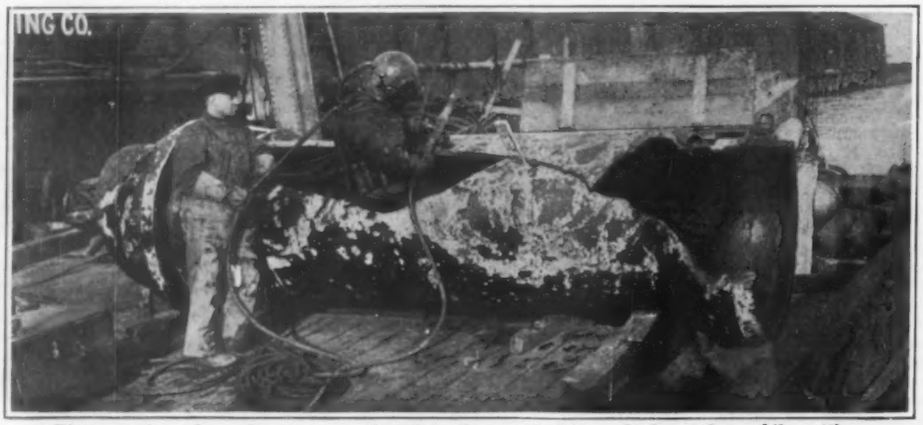
It should be understood that in advance of using the torch at all the ruptured pipe had to be uncovered so far as the overlying mud was concerned. This was effected by dredging and by powerful suction pumps. In this manner an excavation was made with long sloping sides to prevent the mud from sliding back and in upon the divers. And now for a description of the replacement procedure.

The bell of the new pipe section was slipped over the spigot previously enveloped by the flared end of the injured unit, and this joint was sealed by a packing of lead wool, driven snugly into place under water. This left a gap of about 10 inches between the spigot of the new length and the neighboring section from which the bell had been cut. This gap was bridged by a sleeve 5 feet long, 1⅝ inches thick, and with an internal diameter slightly greater than that of the pipes it embraced. This sleeve was carried down on the new unit, and was then shoved lengthwise so as to envelope both of the pipe ends. The job was completed by packing the two joints with lead wool forced home by pneumatic tools; and, as an added precaution against leakage, flanking rings were secured by screw bolts to check any lateral movement of the metal packing as well as the sleeve itself.

The type of torch which helped so much in the execution of the foregoing undertaking is an evolution of a torch conceived by two experts of the wrecking firm almost four years ago. In its pristine form it was essentially a combined electric arc and oxy-acetylene cutting tool which could be ignited under water. This apparatus was used experimentally during righting and refloating of the steamship "St. Paul," which sank at her slip in New York Harbor early in the spring of 1918. But the torch was found to be unreliable and had to be improved before it would cut at depths up to 50 feet. So altered, passages 14 inches in diameter were made with it through the steel plating of that liner. The average time for cutting one of these holes was several hours.

During the righting of the "St. Paul," wire hawsers were led from fully a score of submerged concrete anchoring blocks to A-frames on the up-turned side of the steamer and thence back across the slip to a corresponding number of windlasses. After the ship was restored to the vertical the question was how to get rid both of the 1½-inch hawsers and the blocks. The first plan was to remove the wire ropes and the concrete anchors to which they were attached; but it was finally decided that it would be more expedient and equally satisfactory to cut off the hawsers at points level with the surrounding bottom and to leave the blocks in the trench that had been dug for them. The under-water torch was employed for the job; and the 42 steel lines were thus cut off by one diver in the course of three days.

Subsequently, this torch was radically modified and the electrical feature given a good deal more prominence. Last December, substantially the present tool was employed in connection with the salvage of the U. S. submarine "S-48," which went down stern first while on a practice run off Bridgeport.



Divers posing, above the water, to show how they worked beneath the surface while cutting the injured cast-iron pipe with the torch

Conn. The entire craft was submerged, and only after strenuous work did the crew succeed in elevating a portion of the bow above the surface, thus enabling the personnel to escape by way of the torpedo tube. The wrecker's problem was to attach a suction hose to the boat so that the pumps might drain the vessel's afterbody sufficiently to bring about her refloating. The simplest way to reach the inner hull was by way of the motor-room hatch, 70 feet below water; but the hatch was sealed and locked. The problem was to cut a hole through the center of the cast-steel cover, and thus to release the mechanism that held it shut. The torch did its work well and speedily.

When plans were made for carrying out the repairs on the Staten Island conduit, the salvage engineer who was largely responsible for the existing subaqueous cutting apparatus realized that heavy cast-iron, with its high remelting point, would require more intense heat to effect the needful fusing. Accordingly, the torch was suitably altered to meet this condition. The device used relies upon the action of an electric arc in combination with a suitable "cutting gas." Just what the latter is is not disclosed. The new instrument is apparently capable of employment at any depth and in the coldest waters where it is at all practicable for a diver to labor for any length of time.

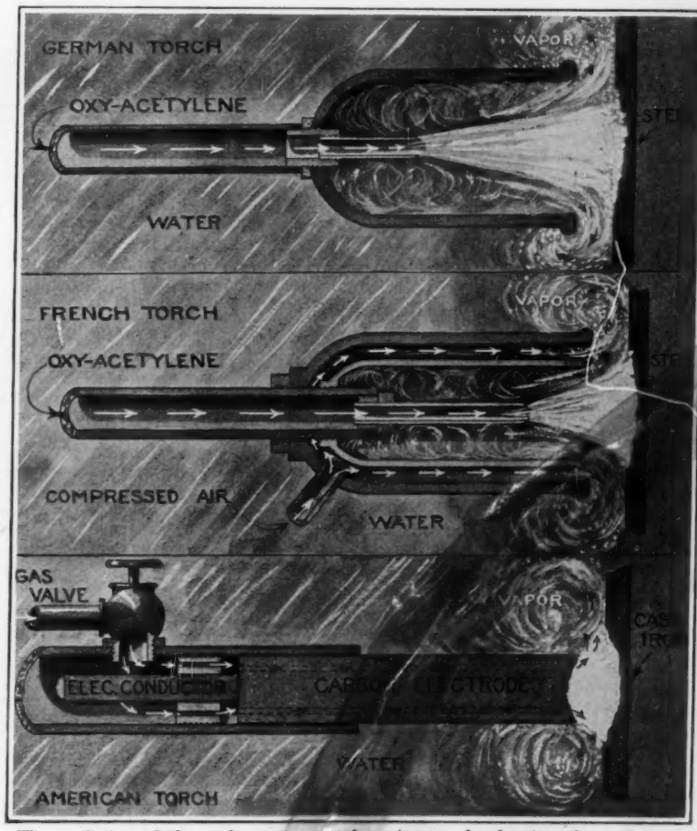
The get-up of the torch is very simple, consisting principally of a single carbon electrode pierced longitudinally by two parallel small tubes through which the gas is fed to the zone of the arc. The quantity of gas can be controlled by the diver agreeably to the depth at which he is working and the particular needs of his job. The current for the arc and the gas for the jets are distributed from the floating base by a hose containing the electrical conductor. When the diver has reached his objective, and is ready to begin operations, current is switched on, and he induces the fusing arc by bringing the tip of the electrode within a fraction of an inch of the metal to be attacked. The moment the electrode is moved away from this proximity, the circuit is broken and the arcing ceases. A good deal of skill, born of practice, is demanded on the part of the diver to keep the tool functioning steadily. Much of the work performed by the gas is to create a vaporous envelope about the electrode so that the arc can direct a large measure of its intense heat against the metal to be cut.

Under-water torches for kindred service were first tried out by the Germans quite 10 years ago; and the oxy-acetylene gas was fixed in a cup-shaped nozzle which, in effect, was a miniature diving bell. A portion of the hot and expanding gas in the cup tended to push the water outward and to hold it at bay while the central flame acted upon the object to be pierced or severed. At shallow depths, and against comparatively thin bodies of iron and steel, fairly good results were obtained during tests, but the torch had little practicable value in very cold water, at greater depths, or when contending with thicker metallic masses.

During the war, the French naval authorities made strenuous efforts to adapt the regular above-water, oxy-acetylene torch to subaqueous service, and to this end they endeavored to improve upon the earlier submarine torch of the Teutons. Experimentally, their torch did perform at greater depths than had been possible with the German apparatus; but it seems that the tool did not reach a thoroughly practical stage. The stumbling block was the acetylene. This gas ignites explosively when at a pressure of approximately 30 pounds. For under-water work, the pressure of the burning gases must be considerably greater than that of the surrounding water; and as the depth increases beyond 20 feet the action of acetylene becomes very uncertain.

To overcome this difficulty, the French devised a torch which used compressed air in addition to oxy-acetylene, and this air, at a sufficiently high pressure, was projected from an annular opening outside of the oxy-acetylene torch-chamber. This arrangement was counted upon to create a vaporous focus or cavity within which the cutting flame could operate—the pressure of the oxy-acetylene being much lower than if the disruptive action of that combined gas alone had been depended upon to hold the water away from the incandescent jet. While the French torch was an advance, still it seems to have left much to be desired; the effectiveness of the tool was limited by the burning range of acetylene. The maximum depth to which this torch was tested was about 29 feet. In its 1918 form, the torch had to be lighted above water, and if extinguished while submerged it was necessary to return it to the surface for reignition. Latterly, it is reported that the French tool can be relighted under water by chemical means.

Plainly, the American torch is a notable advance in the art owing to its simplicity of construction, its dependability, its method of establishing the cutting arc when submerged, and its performance at any working depth. It has reached its present state after lessons learned in applying it to numerous and varied submarine wrecking tasks. The question may reasonably be asked, Why would not power-driven subaqueous cutting tools answer fully as well as the torch? This query has been answered by jobs in which the rival apparatus have been used by skilful men. For instance, during the refloating of the U. S. transport "America," in 1918, two expert divers took five days to remove by drilling a ⅜-inch plate. On the same ship, a similar plate, at a depth of 61 feet, was cut through by torch in a single day's work. Later, the wreckers, while engaged on the "City of Lahore," were obliged to use submarine drills because the under-water torch was not at the time available; and their experience then confirmed the results of drilling within the "America"—disclosing the great superiority of the torch.



The evolution of the under-water metal-cutting torch, showing the main features of the German, the French and the American apparatus

Method of Breaking Shells of Chicha Nuts

ALL of us know that certain classes of nuts, such as are found on the table at holiday season, are difficult to break, but few of us would believe that in order to crack the shells of certain valuable species, it is necessary to resort to peculiar and original industrial processes.

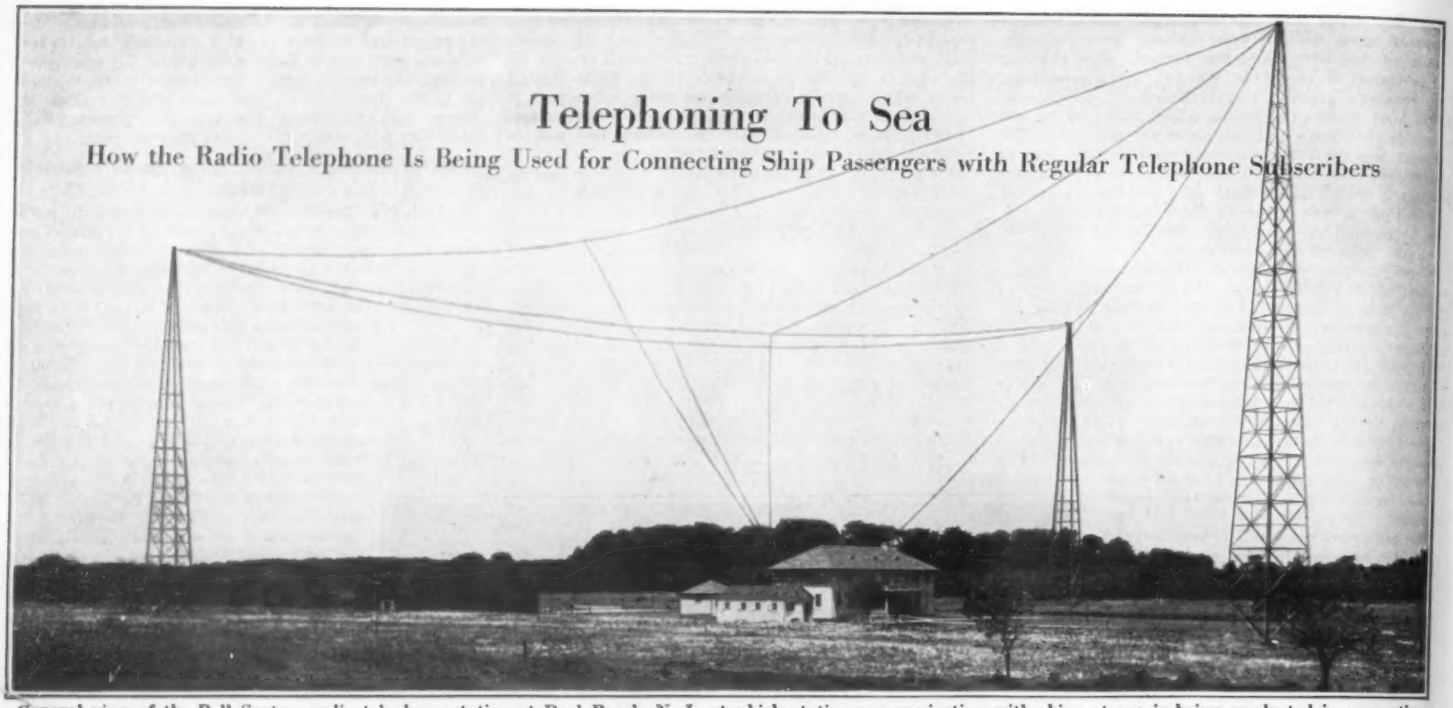
Chicha nuts, which are grown in certain portions of South America, were used during the war as a source of charcoal for gas masks, and as the kernels are a valuable food, such nuts would meet with a ready sale at the present time. However, great difficulty is experienced in breaking the shells without destroying the kernels, as a load of about 1800 pounds is necessary to crack the outer covering. The attention of the bureau was brought to this matter, and as a result of some experiments, it has been found that such nuts may be broken quite easily by means of liquid air. The nut is immersed in liquid air for about half a minute, which is long enough to make the shell extremely brittle and does not penetrate or damage the kernel. It may prove profitable to install plants for the manufacture of liquid air in the vicinity where these nuts are grown, but, of course, the commercial aspect of the proposition is something with which the bureau has not dealt.

Piping Made of Paper as a Manufactured Article

A FRENCH inventor, M. Dalery, proposes to make use of paper on a commercial scale for the manufacture of water piping and the like by an improved process. The pipe is made up by winding paper in a very tight manner, with the use of a suitable adhesive compound. The sections of pipe are formed in a machine of the type already employed in certain manufactures, the paper or light pasteboard being wound directly upon the mandrel or shaft of the machine, using a tank containing the adhesive substance, which is placed at a higher level in order to secure a downward feed during the winding operation. The last layers are impregnated with tar, then the pipe is given a covering of bitumen as for gas and water pipes. Suitable measures are taken to produce a large-diameter portion at the end of each pipe section, into which is fitted the smaller end of the succeeding section, then the joint is made tight by a tar treatment and by winding the joint with a strip of 3-inch tarred fabric. Tests were made with the new piping in order to set forth the three principal characteristics which are required; that is, tightness, strength against interior pressure and good preservation. As concerns the tightness of the piping, several sections were mounted in the vertical position and the bottom was well stopped up, water being placed in the pipe and allowed to stand for 21 days. At the end of this time there was no trace of leakage to the outside of the pipe, so that this test appears conclusive. To ascertain the strength of the pipe when subjected to internal pressure, a section of pipe was stopped up by plugs and was placed in connection with a source of hydraulic pressure by a tube passing through one of the plugs, while a pressure gage was mounted on a tube passing through the other plug. The pipe burst at a pressure of 20 atmospheres, which was a very good result. But the joints did not prove to be very strong, and would only support four atmospheres. This, however, is a detail and is, of course, subject to improvement. Tests were next carried out as regards the preservation of the piping, but as the element of time is here concerned, these were, of course, more difficult to execute in a satisfactory manner. The sections were immersed in a water tank, and at the end of 3½ months a considerable disaggregation was observed, due to the fact that the adhesive compound had dissolved in the water. It would seem, however, that this difficulty could be easily remedied by the choice of a suitable waterproof adhesive substance. Besides, the result was largely due to the entrance of water by capillary action through the end of the pipe, which had not been well protected, and on the other hand, when in normal use the end of the pipe is not subject to this action. Other tests with the pipe laid in the ground showed very good results as to preservation. On the whole, it appears very probable that piping made of paper can be manufactured as a practical article, at least for numerous purposes. Machines must be found to wind the paper in a very tight manner. Such machines already exist, and it will suffice to adapt them to the present use. A method of this kind appears to be very promising, especially in view of the high price of metal. For temporary plants it is evident that such piping might render great services at a small cost. The almost unbreakable nature of this article is a point to be considered, together with its light weight, in the question of transportation. Some of its uses which are more obvious might be mentioned, namely, as piping which is not buried in the ground and is therefore not subject to damage for this reason; then it could be used as a protection for metal pipes against cold, and especially as a steam pipe covering. Electric cables could also be protected in some cases. In short, the method is one that deserves careful consideration and thorough investigation.

Telephoning To Sea

How the Radio Telephone Is Being Used for Connecting Ship Passengers with Regular Telephone Subscribers



General view of the Bell System radio telephone station at Deal Beach, N. J., at which station communication with ships at sea is being conducted in connection with the regular telephone lines

THE day is not far distant when every passenger steamer at sea will be just as much within reach of the regular telephone system and just as much an integral part of that system as the modern city apartment. There is nothing new in this prophecy: it has been talked about and virtually promised ever since radio telephony came into existence a decade and a half ago. But today we are making very substantial progress toward the early realization of telephony from ship to shore, along with all the other things promised for radio telephony.

Already we are telephoning to sea over the regular telephone lines. Experiments are being carried on, and while much remains to be done in the way of perfecting and refining the various details of this combined telephone and radio telephone system, the results indicate that the idea is feasible and most likely practical. A person talks over the regular telephone line and listens in the same manner as usual. The other person on board ship also speaks in the usual manner. Aside from occasional interference from other radio transmitters, especially radio telegraph, there is nothing to indicate that the conversation is other than an ordinary telephone conversation.

Recently an official of the Bell System was called to the telephone at his residence in New Canaan, Conn., to answer a call from Captain Rind, who was on his ship the "America" of the United States Line as it approached New York. At the time, the "America" was still 24 hours from port, or about 370 miles distant.

"Hello, this is Captain Rind."

"Captain, this is Mr. Thayer of the telephone company. I'm up in New Canaan. I understand you are three or four hundred miles at sea."

"Yes, we were 370 miles from Ambrose light at 7:30. We expect to dock tomorrow evening at 7 or 8."

"What kind of a trip are you having?"

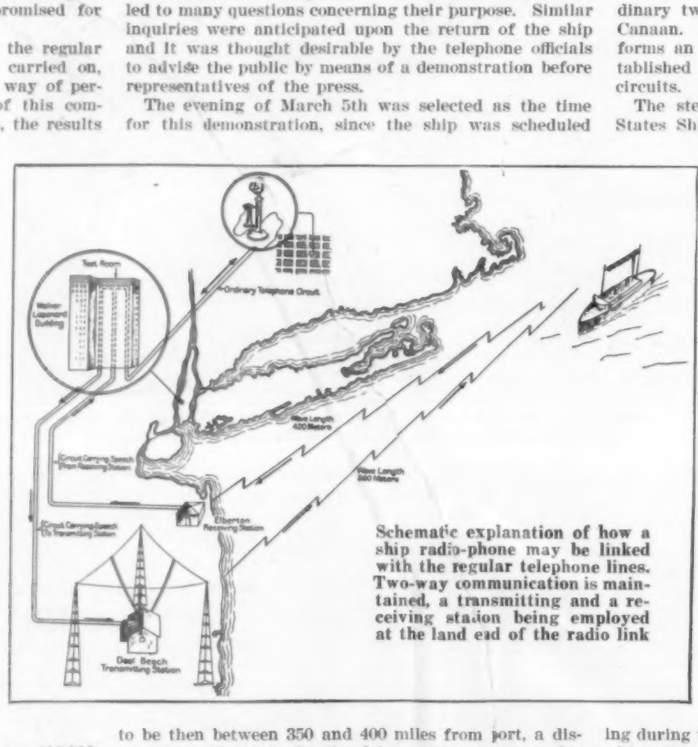
"We're having a good trip for this time of the year."

"Well, I'm glad to have had the pleasure of speaking to you. I think it is fine that we can meet and talk this way."

That was how the conversation ran. Over 100,000 persons heard the conversation; for the radio link, connecting the wire telephone system with the ship radio set, makes use of radio waves that may be intercepted and heard with the usual radio receiving set. It may be that at some future date some combination of wave lengths will be employed to make the radio telephone link more or less private; but for the time being the conversations are more or less public because of the large number of amateur receiving sets within range.

Preliminary to her last voyage to Europe, the steamship "America" had been equipped with a radio telephone set. Throughout the eastward trip tests were carried out between the ship and the radio telephone station of the Bell System located at Deal Beach, N. J., some 33 miles south of New York in an air line. These tests were overheard night after night by numerous radio amateurs along the North Atlantic coast, and led to many questions concerning their purpose. Similar inquiries were anticipated upon the return of the ship and it was thought desirable by the telephone officials to advise the public by means of a demonstration before representatives of the press.

The evening of March 5th was selected as the time for this demonstration, since the ship was scheduled to be then between 350 and 400 miles from port, a distance considered to be the fair working range, under normal atmospheric conditions, for the radio transmitters both on board ship and at Deal Beach. The success of the demonstration proved that the time had been well chosen; for, with the exception of 10 or 15 minutes during which the wireless waves were subject to "fading," as the radio engineers say, telephoning between the ship and shore proceeded without the slightest difficulty.



Schematic explanation of how a ship radio-phone may be linked with the regular telephone lines. Two-way communication is maintained, a transmitting and a receiving station being employed at the land end of the radio link

The accompanying schematic drawing gives a general idea of how these experiments in ship-to-shore telephony have been carried on. The reader will note that two separate stations are being used on the Jersey coast, Deal Beach being the transmitting station and Elberon the receiving station. For those who are more technically inclined, it might be pointed out that the wire circuit was operated on the four-wire principle between Walker Street and the radio stations, and on the ordinary two-wire principle from Walker Street to New Canaan. A hybrid coil and balancing network, such as forms an essential part of all telephone repeaters, established the union between the two- and four-wire circuits.

The steamship "America," belonging to the United States Shipping Board fleet, is a 28,000-ton vessel engaged in passenger service between New York, Cherbourg, and Bremen. On the trip of which we are writing she carried a large booking of passengers who, during the progress of the tests, not only manifested considerable interest in them but also expressed in no uncertain terms their willingness to talk with persons on shore should they be given the opportunity. These passengers, in turn, had many friends in this country who were equally anxious to communicate with them; indeed, the engineers in charge of the Deal Beach station reported an avalanche of more telephone calls than they took time to count from parties who wanted permission to talk with friends on board. One of these requests actually came by telephone from as far west as Chicago.

The demonstration not only brought out the possibilities of ship-to-shore communication, but also illustrated its shortcomings—shortcomings which are, in large measure, characteristic of radio in all its forms. At regular intervals throughout the test, which lasted for over an hour, intelligible communication with the ship was prevented by interference from spark stations, most of which were on vessels at sea, the spark stations near New York very generously having stopped their sending during the period of demonstration. The elimination of interference between stations, all engaged in carrying commercial business, is one of the important technical problems of radio still waiting solution.

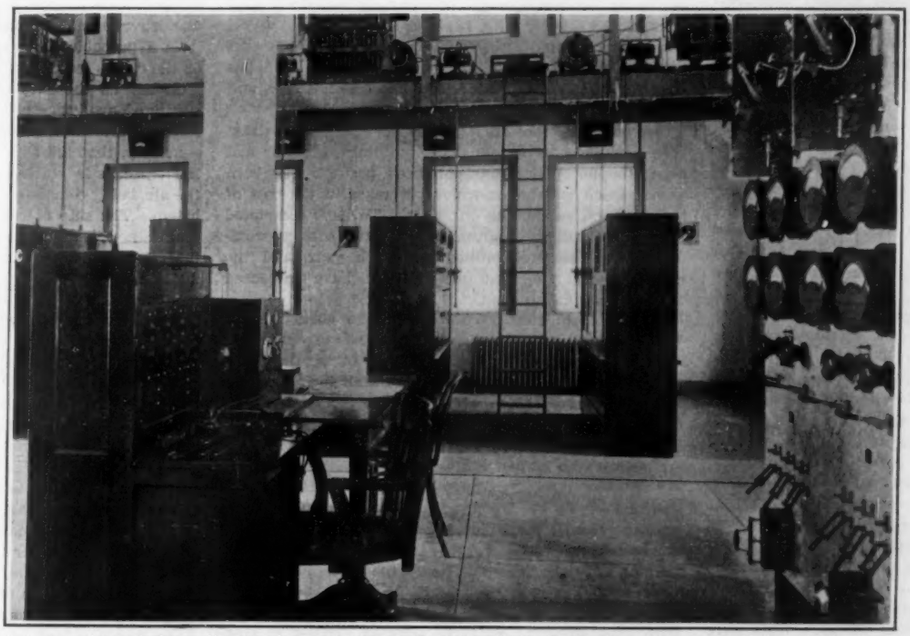
Another limitation of the radio telephone was forcibly brought out by the number of telephone calls which came in from persons who said they had simple radio sets in their homes and were listening in on the whole conversation between the speakers on shore and on the ship. A telephone message, once it has been given to

the radio transmitter for propagation through the air, is virtually public property, and as upwards of one-half million radio amateurs throughout the country know, it is the simplest matter in the world to listen in on such a message. However, there are ways in which secrecy may ultimately be obtained for the radio link of a telephone system.

Moreover, atmospheric conditions exert a marked influence upon the ease with which a radio message travels through space. These conditions vary greatly from day to day and from hour to hour. This can well be illustrated by the observations which have been made in connection with the radio link of the telephone system, operating between Long Beach, California, and Catalina Island. This radio link was described in full in our November, 1920, issue, as well as the interesting experiments between the steamship "Gloucester" and Deal Beach, and the regular telephone system. The distance between the mainland and the island is 30 miles, and the sets have been made sufficiently powerful to transmit speech across this distance under the most unfavorable conditions. On the other hand, it has been found that this amount of power is sufficient under exceptionally favorable conditions to make these messages readily audible in New Zealand, 5000 miles away. One of the most difficult radio problems the telephone engineers have encountered is the transmission of a fixed quantity of current over the telephone lines in spite of the extremely variable intensity of the radio signals which are to be relayed over these lines.

Another atmospheric phenomenon which is a source of most serious disturbance to radio transmission and which thus far has baffled all attempts to eliminate it, is the so-called "static." Fortunately, for the demonstration we have just described, there was very little static present. Its occurrence varies greatly with the season of the year, and in the northern hemisphere is particularly troublesome during summer. Indeed, there are hours and even days together when all but the strongest radio signals are obliterated.

The radio link—the spanning of space between bits of regular telephone system—must come. The difficulties in the way of everyday, practical ship-to-shore communication are numerous and formidable, but they are certain to be brushed aside just as so many other obstacles in radio have been overcome.



Interior view of the radio telephone station at Deal Beach, N. J., showing the operator's desk in the foreground and the antenna connections on the balcony

Pure Cellulose with the Aid of Chlorine

THE manufacture of caustic soda by the electrolytic process is of the highest commercial importance and technical interest, for it enables the production of a very pure product at a relatively low cost. The process consists in passing the electric current through a solution of common salt, contained in a specially devised cell. The products are caustic soda of 99 plus per cent purity and the gas chlorine. The fact that chlorine gas is produced along with the caustic soda is at the same time both an advantage and a disadvantage. Chlorine is a valuable product, both of itself and when converted into bleaching powder by passing it into lime. But the demand for caustic soda is almost always greater than that for bleaching powder or for liquid chlorine, sold as such in cylinders. The result is that when the production of caustic soda is sufficient to meet the demands, the simultaneous production of chlorine gas is too great for the market to absorb. The gas cannot be released into the atmosphere very well, for it is very corrosive and would cause considerable damage to crops, vegetation, buildings, and all metal work with which it came into contact. So much effort has been given to developing additional uses for the gas.

Italy's production of caustic soda has been made largely by plants which use the electrolytic process, and the Italian technologists have been working on this problem. A recent article in *Chimie et Industrie* (1921, 287) by Umberto Pomilio is concerned with the use of chlorine to produce pure cellulose, well suited for the manufacture of paper, from various raw materials, such as poplar wood, hemp and hemp refuse, straw, esparto grass and other vegetable fibers.

Cellulose is the principal constituent of all vegetable matter: of wood, grass, hemp, cotton, the stalks of the corn plant, etc. But in the natural state cellulose is mixed with a large number of other compounds, which do not differ very much from it in composition and properties, but which must be removed before the cellulose can be used to make paper and paper products. Fortunately, these impurities are much more subjective to chemical reagents than the pure cellulose itself, and the methods of preparing the pure product depend primarily on this selective action of the reagents employed.

The use of chlorine as such a reagent is not altogether unique, but its practical application on a large scale with successful results is a new development. Combined treatment with caustic soda and then with gaseous chlorine has been used, but while the cellulose thus obtained is very superior in quality, the yield was too small to make the process applicable commercially. Then in removing ligno-cellulose (one of the cellulose derivatives found in many crude cellular raw materials along with cellulose itself) from jute, chlorine has been used in conjunction with other reagents. This process has been criticized not alone for its low yield but equally because a rather poor grade of product is obtained, due mainly to the long-enduring action of the caustic alkali on the cellulose, resulting in its partial decomposition or hydrolysis, as it is called. Again, in separating the cutose and cuticular substances from linen fiber, gaseous chlorine has been used with success.

Several patents have been taken out on processes in which chlorine gas has been used more generally to produce pure cellulose, but these processes have required too costly and intricate machinery to make them of any real industrial importance, or were found to give poor products, due to the fact that the chlorine reacted with non-cellulose substances in the crude fiber and generated thereby large quantities of hydrochloric acid, which had a destructive action on the cellulose itself.

The present process has been used in the Pomilio chemical works since 1919. At the present time ten tons of cellulose are produced a day and the plant is being increased to a capacity of four times that quantity. While various crude fibers can be used, most of the raw material is hemp and hemp waste, as the plant is located in Naples, in the southern part of Italy, where hemp is cultivated largely. There does not seem to be any doubt that a pure, white cellulose is obtained by means of this process.

Both chemical and microscopical tests are cited to prove that the cellulose is free from all impurities. Paper made with the pulp possessed great rigidity and a marked degree of translucidity; in other words, was of the quality of a high-grade bond writing or printing paper.

The process consists of three operations, soaking in a dilute solution of alkali, chlorination with gaseous chlorine and washing with a weak alkali solution. The mechanical operations involved are similar to those used in the ordinary paper mill, and the chemical operations, especially that of chlorination, can be controlled so well that the best yield of the best quality product can be obtained without any great difficulty. For every 100 kilograms of crude fiber there are used 28 kilograms of moist chlorine gas, 16 kilograms of coal, 6 kilograms of chloride of lime and 5 kilograms of soda or its equivalent of quicklime. The less alkali is used, the more chlorine gas must be used, and inasmuch as chlorine is the product that is to be got rid of, as much as possible of that gas is used, unless the bleaching powder market is strong; then more caustic soda will be used. According to the market conditions for these commodities, the proportions of the two reagents can be varied at will and without interfering with the technical efficiency of the process.

Figures are given to illustrate the economy of the process in comparison with the soda-ash process, the sulfate process and others. One of the main advantages is the reduction in the amount of bleaching powder used. The water consumption is about the same as that of the other processes. Attention is called to the fact that the process can be easily installed in electro-chemical plants which want to use their excess chlorine in this manner, and in large paper plants which possess electrolytic cell installations. There are many points in the process which make it very attractive. It appears to offer a very logical and practical solution of the chlorine problem. It is stated that the Pomilio Company is now experimenting to see whether it is commercially possible to recover the hydrochloric acid produced in the process, and also whether there cannot be developed some industrial used for the chlorinated derivatives that are obtained therein as by-products.

Unusual Demands for Weather Forecasts

THE work of the Weather Bureau of the United States Department of Agriculture touches the activities of the people of the country in numerous interesting ways, many of which are of enormous economic importance. The regular services, such as daily weather reports, hurricane warnings, and information concerning frost, are known to everyone, but some of the special services are so novel as to deserve special notice.

During the last year the bureau has supplied valuable information for those taking part in the national balloon race and the international balloon race which started from Birmingham, Ala., September 25, 1920, and October 13, 1920, respectively; and the elimination balloon race at the same place on May 23, 1921, to determine United States entries for the international race to be held in Brussels. Special forecasts were made and weather reports and advices furnished contestants in these races. Special maps were prepared and detailed information supplied daily.

Other cases in which weather information was of particular importance were the transcontinental record airplane flights and transcontinental aerial mail race in February and March, 1921; the international yacht race off Sandy Hook in July, 1920; United States Army airplane flights from New York to Alaska. A great many special weather forecasts have been made in response to the requests of managers of State fairs, local celebrations, and the like. This form of service is very popular and is increasing rapidly. Also, special advices and forecasts were given in connection with pigeon races. Most carrier pigeon racing associations now depend upon this service and do not release their birds until they are assured by the forecasts that conditions of wind and weather are favorable.

On the day before the national election last fall special forecasts were issued to the press associations and to the chairmen of the National Campaign Committees and to the Presidential candidates. In addition to this unusual service, many other demands are made upon the bureau at various times. For instance, in October and November special reports were prepared each day for the guidance of the United States submarine naval boats, engaged in salvaging the United States submarine "S-5" that was sunk off Delaware breakwater.

Our Point of View

Within the Atom

LECTURES given during March at various American centers of learning by Dr. F. W. Aston of Cambridge made a notable contribution to the general knowledge of the remarkable advances of the moment in physical chemistry. More and more it is coming to be taken for granted that the chemical elements are made up of identically the same stuff, and that they differ only in their structural arrangements. More and more the passage from one element to another which has so dumfounded science when it was first observed taking place spontaneously is coming to be a matter of course and something which we may ultimately hope to control.

There are several cautions which should be observed in this connection, however. In the first place, whatever our assurance that we shall be able to convert one substance into another, the offhand assumption that it will be profitable to do this is not justified. As regards actual transmutation, we can today extract gold from seawater, from the air, from almost any rock or earth. We do not, however, attempt to extract it save when it is present in quantities above the commercially profitable minimum. It is of little comfort to get a dollar's worth of gold from any source at a cost of $1.05. So it will probably be, if not permanently at least for a very long period, with any efforts to convert the commoner into the rarer elements. The question of economics is outside nature's domain; but the man who hopes to get rich by making gold out of lead or copper out of granite or gasoline out of water by atomic transfer must have a process that costs appreciably less than the value of its products. And this the most enthusiastic cannot predict.

The same condition holds with reference to the conversion of atomic energy, or of matter into energy; and here even less attention has been paid to commercial limitations. The chemist is apt to assume that commercial transmutation will not be possible; he is equally apt to forget his traditional conservatism and assume that the development of energy from atomic sources, when once realized, must necessarily be profitable. Actually, it may very well happen that to release 100,000 horsepower we would have to spend more than that amount; and then atomic energy, like transmutation, would be for the laboratory scientist alone.

Another point which is worth emphasizing is that the present trend of science does not in the least contribute to the respectability of alchemy. What we are now doing is very reminiscent of what the alchemists were talking about. But we flatter these old dreamers beyond measure when we read into their vaporous words and ineffective attempts at practice any particular significance. They were trying to do something—what, they did not know. Their statements are purposely so vague as to mean nothing and hence anything. Any development, in any direction, which modern science might by any possibility make, could without difficulty be tortured into accord with the vague and meaningless phrases of the seekers for the philosopher's stone. Parallelism between what we are now doing and what the alchemists were trying to do is not to be sought without doing the greatest injustice to modern science.

Trouble-Makers and the Treaty

THERE is a certain type of individual—we have all met him—who is never so happy as when he is unhappy. He has "grouch" for breakfast, grievance for lunch, and dines sumptuously every day on suspicion, envy, and well-seasoned hate. In every sphere of human life you may find these unfortunates; but nowhere do they bulk so big, and blare so noisily, as in politics and in the press. Of the hate-mongers and misery-merchants of the press we have one full-grown specimen in New York; and, alas, some notorious representatives, also, in the halls of Congress. Just now they are doing their best to discredit the noble work which was done by our President and the Secretary of State at the recent Disarmament Conference.

So far as the navy is concerned, they are explaining how that Machiavellian pair, Great Britain and Japan, have "put one over on us" in the matter of naval readjustment. These countries have gained everything, we are told, while these poor unsuspecting United States have been stripped to the bone. Now, it seems like a waste of time to have to run to earth, expose, and kill a lie so palpable as this; but it has been done, and most effectively done, by the Assistant Secretary of the Navy, Theodore Roosevelt, who, in answer to the question as to what the United States gets in the way of benefit out of the Naval Treaty, points out that she gets a navy equal to that of Great Britain, and superior to the navies of the other powers. Furthermore, the United States moves up to this position at a greatly decreased cost, compared to what the cost would have been had naval competition persisted. If the naval programs formerly projected had been carried through, the heavy fighting strength of our navy compared with that of the others, on a basis of 100 per cent, would have been: United States 100, Great Britain 106, and Japan 87. As the result of the Treaty the ratio has been fixed at United States 100, Great Britain 100, and Japan 60.

Not only has the Treaty given us a better position than we would have held if the building programs had been completed, but that enhanced position has been accompanied with an enormous decrease in the cost of building and supporting our navy. To have completed the 1916 building program would have cost approximately two hundred million dollars a year, and the cost of supporting our navy would have increased by a like annual amount.

Such is the simple truth about the effect of the Washington Conference upon the interests of our navy; and when the public realizes these facts, they will understand what an unpatriotic and malicious course is being pursued by those who are endeavoring to poison the minds of the public against this Treaty, by representing it as having impaired the relative fighting strength of the United States Navy.

Not in any direction whatsoever has the United States been a loser by the Treaty, and in many directions not only the United States but the world at large has been abundantly enriched. A great thing was done when the nations were led to gather round the table and discuss problems which in a former age have been breeders of hatred and war; and to discuss them so frankly, and with such sincerity, that the solution arrived at postpones the possibility of war, at least for a decade, probably for a generation, and possibly for all time to come.

Why not? The misery-merchants and the hate-mongers tell us, as the Germans told us before the war, that war is a biological necessity; that it is inevitable, and so on. We believe that statement will be proved to the devil's own lie, and that, as we have learned to substitute reason for force in disputes between man and man, city and city, state and state—so we have now entered upon the last stage of this development, and shall witness the same substitution of reason and law in the adjustment of disputed questions between the nations of the earth.

The Recent Airship Accidents

THERE can be no question that the tragic loss of the "Roma," following all too closely upon the disaster to "ZR-2," has had a profoundly disquieting effect upon the public mind, and has raised a doubt as to whether lighter-than-air ships are practicable and safe. In the presence of such disasters it is easy to fall into such false generalizations, and draw conclusions that are not justified by the facts. Bearing this in mind, we venture to state that there is nothing so far disclosed with regard to the wreck of these two ships which justifies the belief that the theory of airship construction is at fault, or that transportation by this means is a dream which can never be realized on a large and profitable scale.

Although at the present writing the investigation of the wreck of the "Roma" is still being held, and no official statement has been made as to its immediate cause, we venture the prediction that, as in the case of the "ZR-2," it will be found that the disaster was due to a too sudden application of the controls, when the ship was flying at high speed. Air resistance increases approximately as the square of the speed, and if, as has been frequently stated, the "Roma" was being driven with the full power of her six Liberty engines, a sudden depression or elevation of her elevators would bring a proportionately heavy strain upon the ship itself, upon its elevators, and upon the control cables leading therto. These were the operating conditions that brought about the wreck of "ZR-2." In her case it was the longitudal girders of the hull which proved unable to stand up against the lateral bending stresses developed by a sudden reversal of the rudder when she was traveling at high speed. In the case of the "Roma" it is a probable presumption that either the elevators or the cables leading to the elevators gave way.

So far as the ship and the medium in which it is sustained are concerned, there is this fundamental difference between a ship of the sea, and a ship of the air—namely, that the ship of the sea, being only partially immersed, is in stable equilibrium, whereas the ship of the air, being completely immersed, is in unstable equilibrium. The ship of the air, like the submarine, can be maintained in the horizontal plane, if it is desired to fly directly in such a plane, only by the proper relative adjustment of the weights and the sustaining gas in the gas bags, and by the proper manipulation of the elevators. Even at that, when high speed is attained the airship has a tendency to proceed on a wave-line course, which is alternately above and below the true horizontal course.

Now the "Roma," according to published reports of eye-witnesses, was flying only a few hundred feet above the ground and at high speed, and it is quite possible that some rather large and sudden deviation from the horizontal but a too sudden and too large movement to the elevators, with the result that something gave way.

If our surmise be correct, it follows that, both in the case of the "ZR-2" and the "Roma," the failure was a purely mechanical one, and, therefore, can be provided against by adopting a more robust construction in future ships. The quartermaster, it is true, may in each case have shown a lack of good judgment; but even in the most skilled of men that is liable at times to happen. Therefore, it would be the part of wisdom for the airship designer to provide against failure of the human element, by giving something more than simple stress-diagram strength to such parts of the airship as through temporary lack of judgment or panic in emergency, may be subjected to abnormal stresses.

Doctors and Near-Doctors

THE public is ever impatient of the physician's doubtful diagnosis, of his inability to explain disease in a word and cure it with a word. It is ever eager to welcome a simple statement of why we get sick and how we may get well again. If this statement has any degree of inherent plausibility, it will impose upon large numbers of intelligent people.

A case in point is the newest school of healing, "chiropractic." Every physical process is of course directed through the nerves. These lie in part in the spine, branching off to their destinations. Spinal dislocations lead to pressure of bone on nerve, inducing paralysis and other disorders. Aside from the specific cure which resetting will effect, it is clear enough that spinal massage will be of much general value.

So far, so good. But the chiropractor makes the generalization that all diseases, of whatever character is due to spinal displacements of a mild sort for which

Our Point of View

he has invented the name "subluxations." He proposes to cure and to prevent *all* illness by fingering the spine and setting right its subluxations. He treats blindness and deafness in this way, though the nerves to eye and ear never leave the skull. Germ diseases that are too well established to be attacked as such he meets with the explanation that infection proceeds *only in the presence of subluxations*—if we but have perfect spines we may with complete immunity carry capacity cargoes of the deadliest bacteria. The chiropractic novice locates with a touch of the finger "subluxations" of which trained anatomists are able to find no slightest trace. The spines of investigators have been X-rayed before and after chiropractic treatment, with no visible change. As more than an adjunct to orthodox medical practice the thing is absurd.

Now the M. D. is compelled by law to be of good character; to have a common education admitting him to a university of standing; to study medicine for four years or more; to pass a stiff examination in his entire field. Then and only then is he free to "diagnose, treat, and claim to cure" under State license.

Anyone lacking the full equivalent of these medical requirements should be excluded from diagnosis, treatment and claim to cure, in no matter what guise; one who without this training practices in any way on the human mechanism is a menace. We cite a typical case, where a thoroughly honorable practitioner of one of these newer schools was treating a troublesome knee. The case was diagnosed as calling for ordinary manual treatment—massage, to call a spade a spade. For six months it got this; and the bone tuberculosis which was at the root of the matter has been diffused throughout the patient's body, so that she is now dying of pulmonary tuberculosis. Treatment without competent diagnosis of the most innocent-appearing malady necessarily involves risk or error as serious as this.

Another aspect is even more vicious. Frankly the chiropractic schools hold out the lure "no preparation needed beyond the ability to read and write." They urge the student to register now, before the State steps in and stiffens the requirements; they guarantee that if he does they will certify him as having met any new requirements which may be enacted before he graduates. An investigator, taking courses at one of these schools, was careful in his final examination in chemistry to answer every question incorrectly—and still he "passed!" Half and quarter hours are substituted for full hours of study to conceal the extent to which an adequate course is not given. Graduates of correspondence schools are certified to practice, though they have never seen the inside of classroom or clinic. The testimonial factory at Davenport, Ia., circulated 100,000 copies of a document attesting to a miraculous cure in a case where investigation showed that recovery was had only after the chiropractor had failed to give relief and had been discharged. The recorded cures in any event follow the chiropractor's own diagnosis—which at best is incompetent and at worst is a deliberate exaggeration. The gentle art of "selling" his wares to the prospective patient is a large part of the course offered the chiropractic student, who in one case is recruited by means of street-corner soap-box orators. A member of the New York County Medical Society found a chiropractor who had been highly recommended to be a man whom he had known six months before as a chauffeur.

These are but the high spots. The reason why chiropractic has attracted persons of such caliber is because it affords a quick and easy way to set up a pseudo-medical practice that will earn specialist's fees, without meeting the requirements of honest medicine. As long as such an opening is available it will be used. To prevent this sort of "professional service" from gaining an established footing as well as to protect the individual patient, it ought to be a definitely established principle that no substitute for a doctor may advise or treat without a doctor's consent, unless he has learned as much as a doctor must learn and has learned it as thoroughly as a doctor must. The proposal now made in New York to license chiropractors or exponents of other cults after a rump preparation of a year or two is in every way bad.

President Harding and American Shipping

IF the Fates be propitious, February 28, 1922, will be a red-letter day in the history of American shipping; for it was on that date that President Harding, appearing in person before a joint session of the Senate and House of Representatives, outlined his elaborate program for establishing an American Merchant Marine. On the same day a bill, prepared under the auspices of the United States Shipping Board, was introduced in both the House and the Senate.

After reviewing our ship-building efforts during the war, which gave us something more than 12,000,000 gross tonnage, at an outlay of $3,500,000,000, and referring to the abortive attempt of the Government to establish shipping lines and run this great fleet itself, at a loss last year of approximately $16,000,000 a month, the President said that the immediate problem before the nation is to turn the ships, and our experience and aspirations, into the effective development of an ocean-going shipping service. As a fundamental requisite for success, the Administration has decided to sell the fleet to private owners at the current market prices, and accept the heavy loss, due to the difference between these and the first cost, as one of the penalties of the war.

So far so good; but, supposing that the sale were made, and that this American fleet were in private hands. There is no possibility, under existing conditions, of the American owners being able profitably to operate the fleet. We pay higher wages, provide better accommodation and better food; are obliged by law to carry a much larger crew, both on deck and in the engine room; must provide more life boats and men to man them; and in general are subjected to much higher operating costs than the competing ships of other nations. Manifestly, if our merchant fleet is to show a sufficient return upon the investment, something must be done to equalize the conditions. The one source from which such assistance can come is the United States Government and its Treasury.

From the Treasury President Harding advises the payment of $30,000,000 annually to the various shipping companies. That, of course, would be a straight-cash subsidy, and as such it would be the consummation of a policy which the SCIENTIFIC AMERICAN has advocated for the past 25 years. Most of our competitors grant subsidies, and have built up their fleets largely by this means. We can compete with them only if we do the same thing.

The President tells us that even this direct aid is insufficient, alone, to offset the advantageous position of our competitors, and he recommends that certain policies be followed and laws passed, which, by relieving the ship owners of various financial obligations to the Government, would still further tend to equalize the situation. Thus, it is proposed that the owners of vessels be relieved of excess profits and other taxes on their shipping earnings; that one-half of the alien immigrants to the United States be carried in American vessels; that Government troop-transport service be abolished, and Uncle Sam's soldiers and sailors carried in American ships; that a Merchant Marine Naval Reserve be established, the members of which will receive pay from the United States in time of peace, in addition to their pay as Merchant Marine seamen; and that joint shipping and rail rates between American ships and American railways be permitted.

Such in its main outline is the shipping bill, and so far as the future interests of the Merchant Marine are concerned, we believe that it will admirably meet the difficult conditions which have brought the post-war attempts of the Government to make use of our great merchant fleet—the second largest in the world—to such ignominious failure.

A Lesson of the Service-Station

GRANTED that the automobile butcher is unreasonable when he drives his car to a mess of junk 50 miles from nowhere, and then expects the mechanically inclined farmer's boy who has started a little garage at the crossroads to locate all its ills and fix them all in half a day. Granted that many—perhaps most—of the complaints about the inefficiency of garages in general, and service stations in particular, are the result of ignorance and unreason on the part of owners, and of unstandardization of design where standardization would be altogether feasible. We can afford to grant all this, and more; and still have room to wonder in what slaughter-house a lot of garage men and a lot of "expert repair mechanics" learned their trade.

We are not without experience of our own and our friends to illustrate all this. But in a recent issue of *Auto*, Mr. S. F. Edge, than whom Britain boasts no more thoroughly competent automobilist, tells a tale of such rare richness that we are moved to substitute it for any of our own. A car which Mr. Edge was driving developed a curious ticking which he was not able to locate. So he took the car in to the manufacturer's service station and put the problem up to the "head tester"—we gather that the American equivalent of this is the boss mechanic, the one man in the place who is supposed to know that particular brand of car backward and forward and inside out. This worthy looked it over, and rendered a verdict that there was a broken ball in the fan spindle, accompanied by a loose fan belt.

Mr. Edge was not more than half convinced, but he proceeded with the car; and the ticking proceeded too. After some 50 or 100 miles of further driving, the car suddenly passed from ticking to a prodigious grinding and crashing familiar to everyone who has ever lost a bearing or a connecting rod while in motion. Mr. Edge stopped car and engine, and fingered the crank to see what he could discover. Three cylinders appeared absolutely sound; the fourth was without compression or other evidence that it was there. A little experiment with the starter confirmed this and raised the hope that whatever was loose was sufficiently out of contact with the moving parts of the crankshaft and the three good cylinders to make limping home on three lungs a possibility. Mr. Edge limped successfully, to the extent of some 25 miles and several moderate hills.

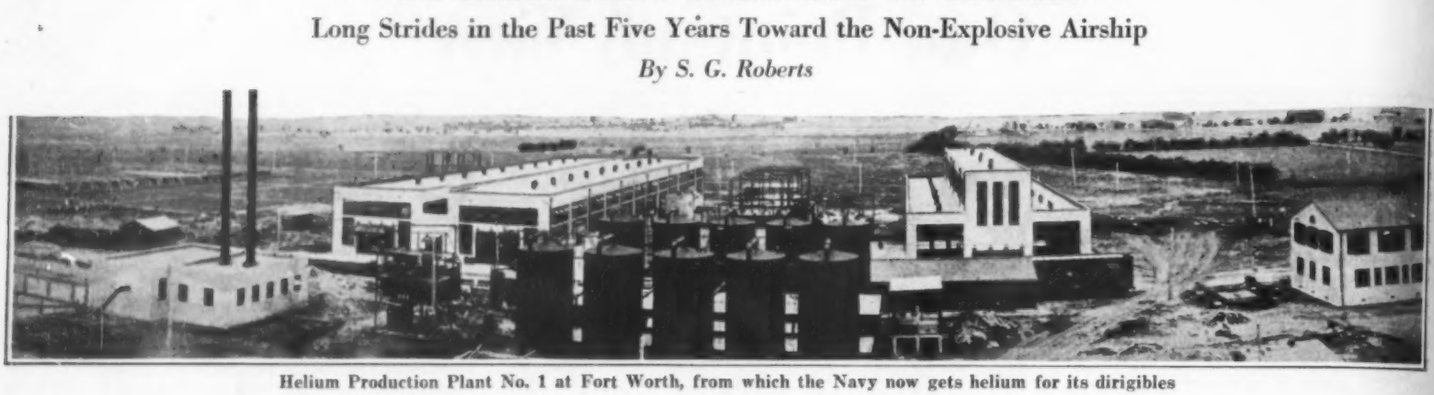
When the car was taken down in the manufacturer's service station to which this trip brought it, the first report was there was nothing whatever to be found of the delinquent piston or its connecting rod—they simply were not there! The suggestion was seriously advanced that this unit had been left out of the car on original assembly, and that Mr. Edge had been driving a three-lunger all the time. Mr. Edge was prepared to accept, if necessary, the implication that the factory was so organized that such a thing was possible; but that he did not himself know the difference between a car that was all there and one lacking a cylinder he could not grant. He finally convinced the mechanic that the fact of the car's having gone suddenly bad implied that it had been more or less good. So the internals of the car were ordered ransacked in a further search for the missing members—and these were found, in fragmentary condition, tucked away in odd corners of the crankcase and the fly-wheel well! The tester who had made the diagnosis casting discredit on the fan assembly was then able to recall that the factory had tried out temporarily a new piston alloy, and had rejected it because of its very tendency thus to crack and fly apart.

This tale is one of those that grows as one lingers over it, fresh absurdities that had previously escaped one cropping out each time one returns to it. We respectfully submit that until something better happens to somebody whose position stamps him as equally an authority and equally to be credited in his narrative, Mr. Edge's experience will have to stand as the world's record in service-station attainment of the ultimate zero.

The Industrial Production of Helium

Long Strides in the Past Five Years Toward the Non-Explosive Airship

By S. G. Roberts



Helium Production Plant No. 1 at Fort Worth, from which the Navy now gets helium for its dirigibles

IN a general way the public is aware that helium is non-inflammable—differing radically in this respect from the hydrogen which has hitherto been employed in balloons and dirigibles. The man in the street can no doubt recall that the Government started about four and a half years ago to devise processes by which helium could be obtained on a big scale for aeronautical purposes; but aside from this understanding of the subject, relatively few of the populace have had more than a superficial knowledge of the sources of helium in this country; of the methods employed for its recovery; and of the problem involved in preserving the gas in large quantities when once garnered from Nature's store.

While we had in our possession on the day the armistice was signed 147,000 cubic feet of helium, averaging 93 per cent pure, still it was not until last December that the gas was put to practical service when the "C-7" was thus enabled to voyage from Hampton Roads, Virginia, to the National Capital and back. To get a better idea of the significance of that achievement it is needful only to bring to mind the many occasions when a spark or a flame led to the utter destruction of balloons or dirigibles by converting their contained hydrogen into a violent explosive. Repeatedly we have been told that atmospheric electricity constitutes a continual menace to hydrogen-lifted aircraft; and it is a matter of record that the navigator of the British dirigible "R-34" took especial care on that account to avoid thunderstorms during the flights west and east across the Atlantic in 1919. And for war uses, the vulnerability to attack of the hydrogen-filled balloon is especially serious.

Helium is one of a series of rare gases, and, curiously, it was discovered first in the sun by means of the spectroscope as far back as 1868—27 years before Sir William Ramsay found it on this globe of ours. Subsequently, other scientists obtained the gas in small measures in the laboratory and for experimental purposes; and up to 1917 there was in all likelihood not more than 100 cubic feet of the stuff available. The cost of its production at the time ranged from $1700 to $2000 a cubic foot.

Helium, next to hydrogen, is the lightest of known substances; and while helium is twice as heavy as hydrogen it is capable, nevertheless, of exerting in a balloon, for instance, an ascensional power of 92.6 per cent when compared with the latter. This is a seeming paradox; but the explanation is a simple one. The buoyancy of a gas is gaged not directly by its specific gravity but by the difference between its weight and that of the air displaced by it. Both hydrogen and helium are so light, judged by the standard of air, that the difference in their lifting power becomes relatively insignificant when applied to aeronautics. One thousand cubic feet of pure hydrogen will raise 75.14 pounds, while a similar volume of pure helium can support a load of 69.58 pounds. A non-inflammable and somewhat more economical mixture made up of 85 per cent helium and 15 per cent hydrogen—which has been proposed for balloons and dirigibles—would have a lifting power of 93.4 per cent of hydrogen alone. In other words, a thousand cubic feet of this combination of gases could sustain a burden of 70.18 pounds.

In 1915, Sir William Ramsay wrote to a former associate in America that the British Government was seeking helium in large quantities for use in airships, and he stated that he had sought unsuccessfully for the gas in the exhaust of coal-mine ventilating blowers. This communication reminded the recipient of work done by two of our physicists, in 1907, in connection with natural gas derived from certain wells in Kansas. That gas had burned badly when turned into the public mains; and upon analysis this fault was proved to be due principally to the presence of a marked percentage of nitrogen. But during the testing of that natural gas it was also disclosed that it carried more than 1 per cent of helium. Beyond being a matter of scientific interest at the time it occasioned no comment worth mentioning.

Under normal circumstances, the recovery of helium from natural gas would not have been essayed, for no one would have thought of substituting an extremely expensive element for the low-priced hydrogen. The state of the art of liquefying gases in 1917 indicated that by existing methods helium might be separated from natural gas at a minimum cost of $80 a thousand cubic feet; and even at this figure the British Admiralty was then ready to contract for more than 100,000,000 cubic feet of the gas—so much did it promise to contribute toward military success. Thus stimulated, and urged on by our own desire to do the utmost to bring the struggle in Europe to a close, the problem was attacked under the general direction of the U. S. Bureau of Mines. Money was allotted generously; and in an astonishingly brief span results were realized that showed we had mastered the fundamental and controlling factors of helium production.

Our war-time activities in this field were, as might be expected, principally of an experimental character, and the plants erected for this purpose were so denominated. These were three in number, and each of them relied upon a distinctive method of extraction. Two of the works were set up at Fort Worth, Texas, and were designated as Plant No. 1 and Plant No. 2, and the third one was built at Petrolia, in the same State, and was called Plant No. 3. Plant No. 1 utilized the Linde process; Plant No. 2 was based upon the Claude process; and Plant No. 3 was arranged to use a truly ingenious departure in the art, the so-called Jefferies-Norton process, of wholly American conception. All of these establishments were supplied with natural gas, containing from .65 to 1.18 per cent of helium, which was tapped from the Petrolia wells, then having a daily output of 15,000,000 cubic feet of gas. This gas, after the extraction of helium and a portion of nitrogen, was then fed into the commercial mains and distributed to Dallas and Fort Worth for heating and lighting.

The separation of helium from natural gas depends fundamentally upon the fractional distillation of gases through compression, which induces heat, and subsequent expansion, which promotes refrigeration—the gases that liquefy at higher temperatures precipitating from the mixture sooner than those that require lower temperatures to bring about this action. The Linde process, originating with Carl von Linde of Germany, relies principally upon what is termed the Joule-Thomson effect, which is promoted by the sudden expansion of a highly compressed gas when issuing from a small nozzle. The progressive cooling resulting from this expansion is sufficient to cause liquefaction of all the gases in natural gas save helium, the one of lowest boiling point. The helium content of the natural gas retains its gaseous state and, in this condition, can be readily drawn off from its liquefied associates.

The Claude process, invented by Georges Claude of France, employs a liquefaction cycle in which an expansion engine is interposed. The Joule-Thomson effect is used, but its value is reduced, inasmuch as the original compression of the gas is somewhat lower than that called for by the Linde system. The maximum chilling is attained through the action of the expansion engine—*i. e.*, the energizing compressed gas, on expanding in the cylinder, and doing work, induces a very decided drop in temperature, and this is ample to liquefy all but the helium in the natural gas.

The Jefferies-Norton process is built, in a sense, upon that devised by Claude and yet is different in some essential particulars. Each unit consists of three expansion engines; and a measure of refrigeration is secured, as in the other methods, by throttling nozzles. The purpose of the newer cycle is to extract the helium by a far more economical use of power. In the Linde system a very heavy expenditure of energy is needed to compress the gas to a high point in order to get thereafter the fullest benefit of the cooling effect of expansion through throttling; and most of this initial power is later on wasted. It is true that the Claude process operates satisfactorily with less primary expansion than the German one—*i. e.*, demands less energy; but again, a large share of this force is dissipated before the cycle is completed. The Jefferies-Norton system, on the other hand, does its work with only a moderate compression of the gas; and much of the power necessary for this service is conserved by coupling the expansion engines to compressors. Thus the engines serve the twofold end of stimulating refrigeration and helping to do some of the compressing. Each of the expansion engines functions at a different temperature, and this permits the hydrocarbons in the natural gas to be liquefied one by one. This

U. S. Navy Blimp C-7 leaving Hampton Roads for the first flight of a helium-inflated dirigible

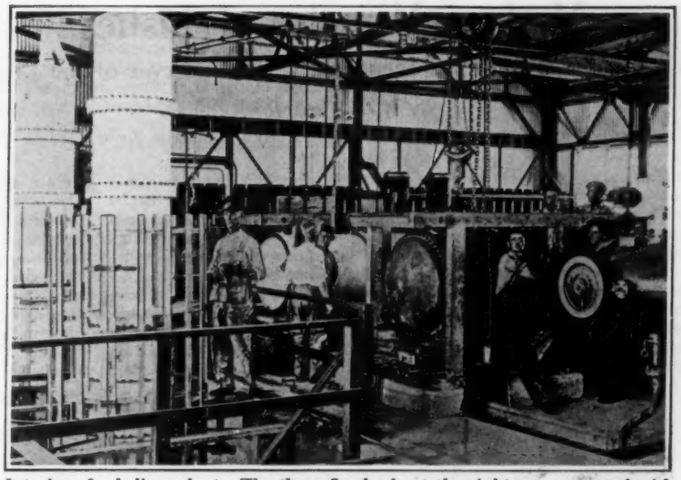
increase in efficiency is counted upon ultimately to lower costs. We say ultimately, because the Petrolia plant is in an evolutional state and some of its features await further study to insure their proper performance.

The Linde plant started up early in March of 1918, and by September of that year it was turning out on an average of from 4000 to 6000 cubic feet daily of 70 per cent helium; and by reprocessing the gas it was able to raise the product to a purity of something over 90 per cent. The Claude plant became active on the 1st of May of 1918, and before that month was out it was yielding gas of a grade ranging between 60 and 70 per cent helium. By the end of January, 1919, when Plants Nos. 1 and 2 were closed, they had manufactured about 200,000 cubic feet of helium. The Jefferies-Norton plant was run for experimental purposes afterwards; and during the past twelvemonth, for short periods, a product was obtained there carrying a maximum of 49 per cent helium. All of the investigational work at the three establishments has entailed an outlay of about $1,200,000. In return, apart from adding greatly to our technical knowledge, we got a commodity worth, at prewar prices, anywhere from $250,000,000 to $400,000,000. The helium furnished by the Linde plant cost us $146 a thousand cubic feet; but the experience gained warranted the price, inasmuch as it gave us necessary data upon which to plan Production Plant No. 1, which is now in full operation at Fort Worth, Texas, under the direction of the Navy Department. This installation has a rated capacity of 30,000 cubic feet of helium per diem, and, based upon operating charges only, can turn out helium 92 per cent pure, at an expenditure of $56 a thousand cubic feet. However, the U. S. Bureau of Mines is confident that, when the Jefferies-Norton process is improved and brought to a commercial stage, helium can be procured by it for as little as $20 a thousand cubic feet. While helium even at the latter price would be prohibitive generally as a substitute for hydrogen, and therefore has no immediate prospect of adoption in civil aviation, still the progress made in the art since 1917 is suggestive of what we may reasonably expect in the near future.

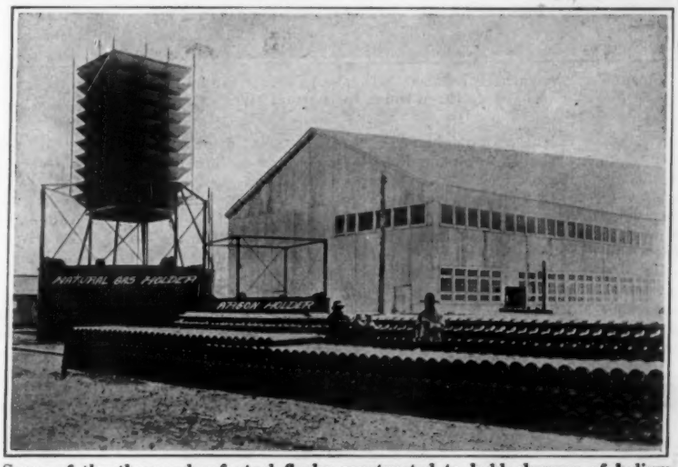
The U. S. Geological Survey has concluded an exhaustive examination of our helium-bearing natural gas and has tabulated just where natural gas of this character can be found and given the percentages of helium present in each of these several fields. The richest sources are located in Texas, Oklahoma, and Kansas, measured in a quantitative and qualitative sense, and less promising areas are situated in California, Montana, and Ohio. These are the only sections of the country wherein it would apparently be practicable to undertake the recovery of helium on an industrial scale. In the three States first mentioned there are wells that emit natural gas carrying more than .50 per cent of helium, but most of the wells, taking them in their entirety, yield less than that.

The origin of helium in natural gas is a moot question, and a subject of great scientific interest. It is the belief of many savants that helium is a by-product of radio-active processes taking place within the earth's crust; and while this might account for the presence of helium in the atmosphere it does not necessarily explain its association with natural gas. Doctor Richard B. Moore, of the U. S. Bureau of Mines, who has had to do intimately with our helium researches, has pointed out that the gas wells in the neighborhood of Petrolia have evolved up to the present time more than 60,000,000 cubic feet of helium. This field covers an area of not more than eight or ten square miles; and he does not believe that within this restricted region there lies underground enough uranium and thorium to emanate so large a measure of helium.

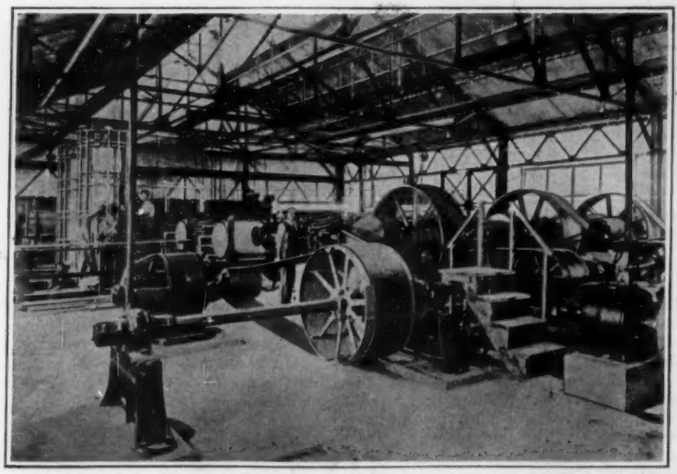
Other students of the problem are of the opinion that much of the helium inside the globe is of primordial origin and in no way connected with radioactivity. In other words, that our subterranean helium had its primary source in the atmosphere, and that it was entrapped in remote sedementary formations or otherwise absorbed or imprisoned during geological changes. If such be admitted, and assuming that the helium has an inherent tendency because of its lightness to migrate surfaceward, then it is not hard to understand why helium is so often found in the gases issuing from mineral springs and likewise in the natural gas identified with petroleum. Be this as it may, and this aspect of the problem can be left to those of scientific mind, the practical angle of the matter is how to garner this gas and to conserve it before it is lost to us in the free air.



Interior of a helium plant. The three flywheels at the right are connected with expansion engines. At the left and rear are the distilling columns into which the purified helium is led



Some of the thousands of steel flasks constructed to hold charges of helium for aeronautical use. The word "argon" is a survival of war-time camouflage



Another interior view, showing the distilling columns that draw off the purified helium. The cylinder at the right belongs to one of the expansion engines used in refrigeration

We have it upon the authority of those familiar with our resources that we are allowing to go to waste every 24 hours more than 1,000,000 cubic feet of helium; and it seems that if we installed proper collecting facilities within certain sections of the country it would be quite feasible to accumulate daily anywhere from 5,000,000 to 6,000,000 cubic feet of helium. The importance of this becomes apparent when we realize that big dirigibles of the capacity of the ill-fated "ZR-1" call for fully 2,700,000 cubic feet of buoyant gas. And even if we take the necessary steps to gather helium from Nature's underground supply, how are we going to amass it until required for use?

The Government has initiated experiments toward this end. The helium heretofore obtained from natural gas by the experimental works and Production Plant No. 1 in Texas has been stored in steel flasks at a pressure of 2000 pounds, and each container has held 200 cubic feet of the element when expanded to atmospheric pressure. The cost of these flasks has represented a heavy outlay, more than $2,000,000 in fact, and for their preservation additional expense of considerable moment has been incurred. Therefore, researches have been instituted looking to cheaper methods of keeping helium after its extraction from natural gas. Up to date these essays have been confined to storing the gas in a specially prepared chamber located in the Government experimental coal mine at Bruceton, Pa. There is reason to believe that satisfactory results might also be secured by similarly utilizing the abandoned workings of other sorts of mines.

While helium may be found of use to man in many directions, and of peculiar value in studies having to do with very low temperatures, its most promising application seems to be in the field of aerial navigation. Aside from the immediate benefit due to an abandonment of inflammable hydrogen, the adoption of helium in its stead will have a decided influence in promoting commercial transportation by lighter-than-air craft. Helium is less active than hydrogen in seeking to work its way outward through the fabric of the imprisoning envelope; and a balloon or dirigible inflated with helium will, accordingly, retain its buoyancy about a third longer than when charged with hydrogen. Heretofore, it has been customary to place a dirigible's engine in underslung gondolas, so located that the exhaust gases from the motors could be kept well away from the bags charged with hydrogen. As a consequence, the propellers have had to exert their thrust off-center, being removed some distance from the longitudinal axis of the main body of the craft. Thus, for a given speed, more horsepower has been required to propel the ship than would be needful if the engines and propellers could be arranged in a fashion more nearly akin to that of the power plant of a waterborne vessel. The employment of incombustible helium would render this possible; would do away with the suspended gondolas and their drag or frictional resistance; and would enable the designer to obtain better results from every horsepower of his prime movers.

Repurification units have been developed by the U. S. Bureau of Mines to be used in treating the helium remaining in gas bags of balloons or dirigibles and which has become weakened through atmospheric diffusion. By this means, the partly vitiated helium can be separated from the commingling air at low cost and quickly made again fit for buoyant service. The purpose of this, of course, is both to conserve the gas and to minimize the expense of its adoption in aviation.

Modern Miracles of Fishes

Some of the Curious Things To Be Seen by a Close Observer of the Piscatorial World

By R. P. Crawford

Photographs by E. A. Sanborn, New York Zoological Society

SEEING fishes in an aquarium is like standing on a corner of Fifth Avenue, New York, and watching the Easter parade of silks, feathers, broadcloth and cutaways go prancing by. The most interesting things about fishes, the same as about people, are often never told.

Fishes aren't so far different from human beings after all. Human nature is very much the same whether in the water or out of it. Life is a business with fishes just as it is with us. Keeping in the social swim in the ocean or backyard pond requires just about as much maneuvering and diplomacy as it does on Fifth Avenue.

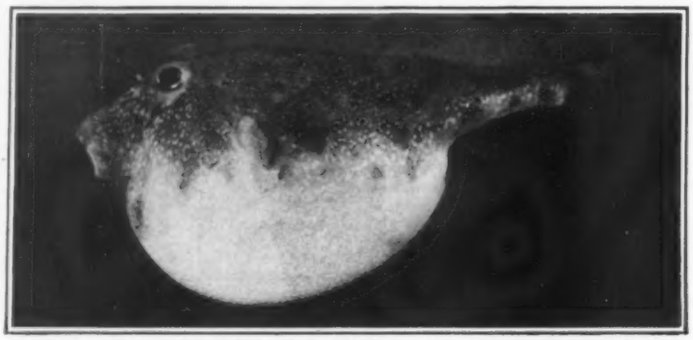
Modern-day fishes are quite different from their ancestors. More properly we should say that our ideas about fishes are the things that have changed. Modern-day fishes hear and think. There are fishes that actually leave the water and have been known to climb trees. Some fishes when they go courting dress up like a young man. They put on their dress suits for the occasion. Modern-day travelers on ocean liners have nothing on modern-day fishes. One of the funniest things is a seasick fish. They have been known to get seasick just like people, especially when being transported in tanks on board a steamer. Seals are not fishes, but since they belong to the ocean may be included here. One at the New York Aquarium died a while ago of fatty degeneration of the heart, just as though he had been a Wall Street broker or wealthy manufacturer.

The old-time philosophers and scientific men used to find a whole lot of direful things for sailors to encounter on the deep. There were constant miracles of fishes then. There were octopuses that strangled ships and crews. The ashes of the sea horse, mixed with wine, would produce coughing, hot flushes and death, and if you were lucky enough to recover, you would forever want to be sailing on the seas. These old-time philosophers didn't know all the fishes that lived in the deep, and so they imagined a lot of monsters and peculiar things therein for good measure.

The modern-day miracles of fishes lie in the modern discoveries about these same fishes that the old-time philosophers found so terrifying. Today there are just two parts of the world whose inhabitants are not quite fully known. One is the deepest jungle and the other is the deepest ocean. The odds belong to the ocean when it comes to cataloging unknown things, because there is such a variety of minute as well as larger forms of life. There have been explorations of ocean depths, but, of course, one can hardly walk about there at leisure and examine everything that comes into view. Knowledge of fishes has always been more limited than that concerning terrestrial animals because the latter are more available. There are few places in the world where any great number of fishes are kept together. By far the most noteworthy is the New York Aquarium in Battery Park, which each year entertains over two million visitors. It is the largest aquarium in the world. But even at that there are no dealers in rare fishes as there are in rare animals, and the aquarium must go out and bring in its own exhibits. It must conduct its own study of individual fishes.

It now seems certain, according to the latest scientific investigations, that fishes do take a snooze now and then, even if they can't close their eyes. Recently the fishes in an aquarium were examined after midnight with the light turned low. The fishes had assumed unusual positions and when the light was suddenly turned up they became livelier. Many fishes in an aquarium are to be seen leaning against a wall or a rock, and there is no question but that they are taking a rest. Furthermore, when apparently asleep fishes take on a darker color than when awake.

Fishes have some mental power, for every fisherman knows how difficult it is to catch a fish which has once been hooked and then has got away. Some of them learn to become tame in the New York Aquarium and from time to time their actions resemble play.



The puffer, shown here inflated, can take in either air or water to make him three times his normal size

Scientists now believe that they have mentality, but probably not enough to be able to associate different ideas.

In another important respect fishes are quite like the great human family. There are any number of species that are quite talkative. It will be surprising to most persons that fishes make sounds, but a number of them are very noisy. For instance, the fish of the Haemulon family, called grunts, grunt. The drum fish drum, the sea ravens, called Sally Growlers by fishermen, growl like puppies over a bone, while the puffers when held in the hand produce certain sounds like the grinding of teeth. The captain of a boat anchored on the Lower Hudson one night reported that the weakfish croaking underneath the boat were making enough noise to keep a light sleeper awake. Just what these fishes were saying to one another, if anything, is not to be printed here. Perhaps they were complaining about the motor boats keeping them awake.

The puffers, which are popular fishes in New York Bay, can claim another point of resemblance to the great human family. They can swell up. When a puffer sees a shark or any other belligerent fish coming hot foot after him, he simply begins taking in water or air, and swells up to nearly three times his usual size. He creates such a big impression that the other fish undoubtedly begins to wonder if he would make such a dainty tidbit after all. The puffer is a good bluffer.

Perhaps the most wonderful sort of fishes are those that can leave the water and even climb trees. The climbing perch is such a fish, and it is often on exhibition at the New York Aquarium. It makes good progress on land, and on special occasions will ascend the trunks of trees a distance of several feet. The fish has learned to use its pectoral fins to keep it from keeling over to one side and uses the fins and the spines on the gill covers to pull itself along. The flying fishes of the South Seas, by the way, have large enough pectoral fins to sustain them on flights up to a quarter of a mile.

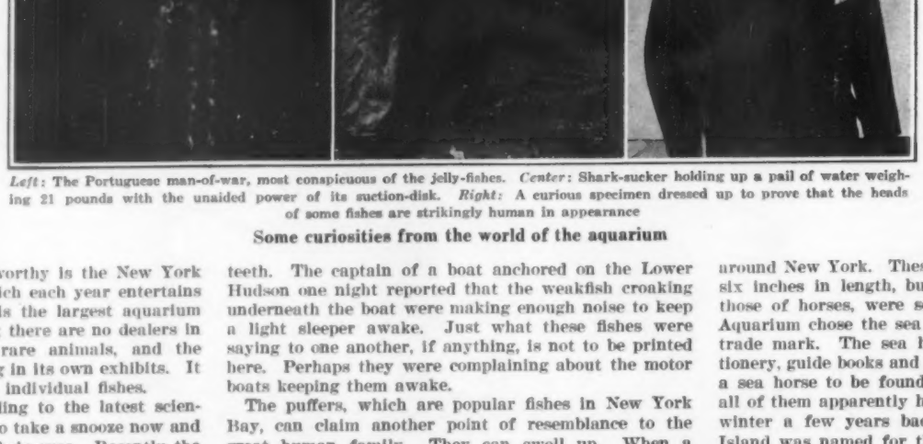
Many fishes can at will change color. A grouper at one moment may be of pale coloration and show few markings. Then he may suddenly settle to the bottom of the tank and reveal a series of dark bands striping his body. A red coney may turn pale, the lower half of its body becoming almost white. Tropical fish, especially, have this power of changing color, and during the mating season assume daring colorations. Scientists have found that these color changes are brought about by the contraction and expansion of color cells, which lie in deep layers of skin. The iridescence of fishes is due to reflecting tissues.

If you are just a plain, ordinary sort of fisherman, who once in a while hikes off to a nearby stream or lake, you undoubtedly will be interested in knowing how the novel fishes to be found in an aquarium are secured.

There are no dealers in rare fishes as there are in animals, and since many fishes die off, the exhibits must be replenished to some extent every year. The New York Aquarium shows fishes from as far south as the Bermudas and Florida, from all the adjacent Atlantic Coast and from all the fresh waters east of the Alleghanies. It is quite different fishing for aquarium specimens. You can't use a hook, and just any fish that you pick up won't fill the bill.

A short time ago the New York Aquarium had built to order a 35-foot boat to use in cruising about the adjacent coasts. Every week during the warm season this boat is stocked with provisions and a party sets out on a fish-collecting trip. In the bottom of the boat is a well, filled with water, into which the fish are thrown after they have been caught. The well is open so that fresh sea water is kept flowing in and out through slats and wire netting. Two or three days are spent on a trip of this sort, looking for curiosities along the coast.

One of the most remarkable things is the change in the kind of fish available in certain localities. Only a few years ago sea horses were amazingly common all around New York. These cute little fishes, only five or six inches in length, but with tiny heads shaped like those of horses, were so common that the New York Aquarium chose the sea horse as its official emblem or trade mark. The sea horse design was used on stationery, guide books and badges. But today there is not a sea horse to be found in the vicinity of New York, all of them apparently having been killed off in a hard winter a few years back. Sheepshead Bay on Long Island was named for the sheepshead, but that fish is no longer found in this vicinity. The mackerel is reported to be quitting the shores near New York.



Left: The Portuguese man-of-war, most conspicuous of the jelly-fishes. *Center:* Shark-sucker holding up a pail of water weighing 21 pounds with the unaided power of its suction-disk. *Right:* A curious specimen dressed up to prove that the heads of some fishes are strikingly human in appearance

Some curiosities from the world of the aquarium

Certain fish are usually to be taken in certain places. For instance the green moray is to be found near coral reefs, being a tropical fish. Flounders, to which family the halibut belongs, are found where there is a sandy bottom. Blackfishes and cunners are usually taken around old wharves. Fishes migrate much like birds, tropical fishes often coming quite far north for the summer season.

The more ambitious searches for aquarium exhibits mean trips to the Bermudas and Florida. On such occasions large tanks are loaded on the steamers and used to transport the fish on the return trips. The water in these tanks must be constantly renewed and usually the steamship pumps are kept busy pumping new water. It is on occasions such as this that the fishes show every symptom of seasickness, getting along very well in the sea itself, but objecting to the rough ride on the boat. When fish are to be shipped by boat they are usually not fed for a day before starting, and their meals are also omitted during the first few days of the journey.

The New York Aquarium made three attempts to secure some porpoises from off Cape Hatteras. The first two attempts were unsuccessful, the small whales dying each time. Finally a seine 1,000 feet long was stretched not a great distance out. When a number of porpoises were behind the net a rowboat at each end was started moving and the porpoises were landed on the beach. In order to keep them from dying they were placed in a salt water pond back of the beach, where they were again fished out the following morning and placed on board a schooner for shipment to New York. Of course, porpoises are warm-blooded, air-breathing animals and not strictly fishes. But since they are warm blooded, they always present a real problem in handling, for when placed in a small amount of water they heat it to such an extent as to make it almost impossible for them to live. So the water has to be changed frequently while porpoises are being shipped, and in the tanks in which they are kept in captivity, the water must be renewed more often than with most fish.

Frequent excursions must be made to the fresh-water lakes and streams. For fish to be found near at hand, tanks are loaded on an old wagon and taken to nearby lakes. Then there are trips by rail to more distant points.

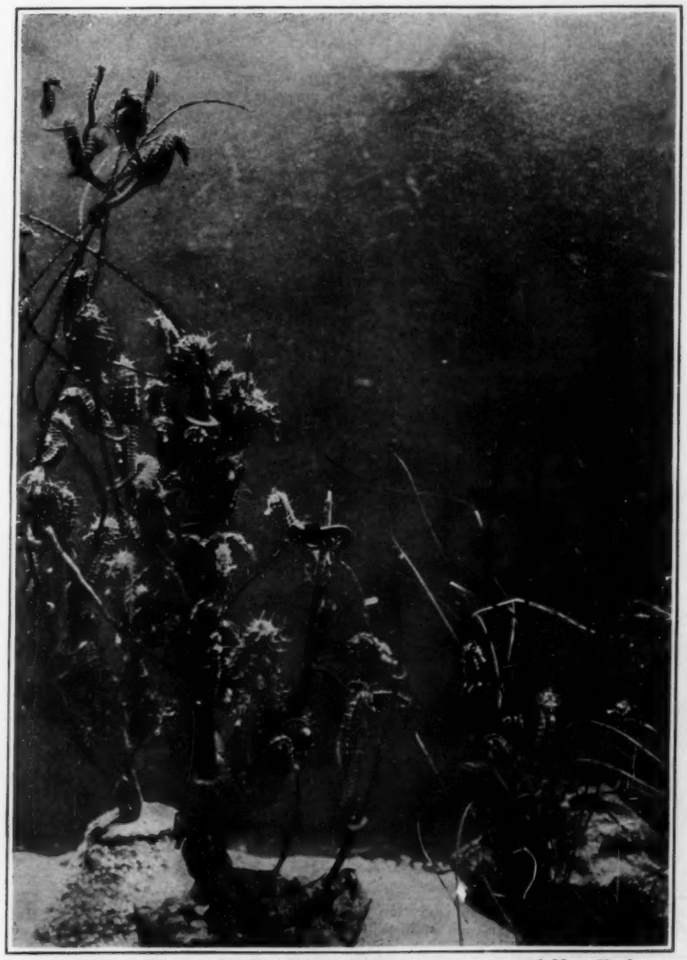
About 250 different varieties of fishes and other residents of the ocean and lakes find a home at the New York Aquarium each year. There are many fishes that live only a short time and others that are perfectly satisfied with their surroundings year in and year out. Efforts have been made from time to time to put herring, menhaden and butterfish on exhibition, but they refuse to live in cramped quarters. On the other hand, a striped bass was perfectly content to live in the aquarium for 20 years! A garpike lived for 18 years and a Pacific green turtle the same length of time. But a big-eyed herring lived only a week.

It keeps one attendant busy half his time cutting up the food for the fish, which consists mainly of other fishes. There are some residents which have to have a special diet. For instance, the little sea horses which used to be so popular required a diet of minute crustaceans called Gammarus, and necessitated the attendants hunting up the fine sea moss on which the crustaceans were found. A sea cow at the aquarium refused to eat lettuce and insisted on eel grass and bread.

Some four different kinds of water have to be kept in circulation. There is ordinary filtered water from the bay for those fishes which are not particular, just so it is salty; then there is sea water for those who would not stand for anything polluted, and, finally, there is both warm and cold fresh water for those fishes requiring it. The sea water originally was brought to the aquarium by tank steamer and this supply has been in continual use ever since, flowing back to a large reservoir through filters. In winter the sea water has to be heated for the tropical fishes and in summer it is equally essential that it be refrigerated for the northern fishes.

Seals always attract attention, but few people know how they are trained. They are not fishes, of course, but they are quite human. They are always full of curiosity and romp about the tank like youngsters. Seals can be fairly easily trained to perform. If they are being taught to play ball, however, the ball must be tossed to them until they accidentally do what is wanted and then they are rewarded with a piece of fish. The seal begins to see that if he does the same thing every time he is going to get a piece of fish, and so it becomes a matter of habit. When a troup of seals are traveling on the road, giving performances, there are always two or three understudies who are learning the tricks.

But the biggest miracle of all is that performed by the starfish. While most fishes have power to regenerate their fins if they are not entirely torn off, this fish can regenerate its arms if they are torn off. Half of a starfish may be destroyed and the other half will grow again. In fact, cases have been recorded where an entirely new starfish grew from only the central group of cells.



At one time these little "sea horses" were common around New York, but they have all disappeared

Tetralin, the New Motor Fuel

THE world's supply of petroleum is limited. It is becoming increasingly difficult to locate new oil fields, and the old deposits are beginning to run dry. It is more apparent each day that substitutes for petroleum and petroleum products will soon enter the market in large quantities; and the sooner this occurs, the longer the petroleum will last.

An artificial situation was brought about in Germany, a few years back, due to the cutting off of foreign sources of petroleum and its distillates. The Germans turned to the one mineral which is found in abundance all over the world, and concerning whose possible early exhaustion we need not be worried—coal. When coal is distilled to make gas, there are obtained, along with the latter, by-products which are much more valuable and important than the gas itself. One of these is coal tar, about which we have heard many times in the past, as the source of raw materials from which synthetic drugs, perfumes and dyes are made. The Germans found that they could make a very fine lubricating oil from coal tar, and also that it would furnish them with a fuel that could be used to good advantage in the place of gasoline.

The use of benzol, also derived from coal tar, for running internal combustion engines has been described in the past, but there is another fuel which can be made from coal tar and which apparently gives much better results. In the distillation of coal tar there is obtained a product, called naphthalene, which is familiar to all in the form of tar camphor, used to keep the moths away from clothes. When the pure naphthalene is treated with hydrogen gas in the presence of nickel, which acts as a catalyst, there is produced an entire series of compounds, according to the number of hydrogen atoms added to the naphthalene molecule. When this number is four, there is obtained tetrahydronaphthalene, or tetralin for short; a colorless liquid with a characteristic odor, boiling at 205 degrees Centigrade. Its resemblance to gasoline lies in the fact that it is fluid at low temperatures and that its ignition temperature is comparatively high (79 degrees). It resembles benzol in that the explosions obtained with it are gentle, and there is no tendency for it to take fire in the cylinder.

The main advantages of tetralin are its high specific gravity, 0.975; and its equally high calorific power per unit weight, which is 11,000 calories per kilogram against 11,000 for gasoline. On the volumetric basis, the calorific power of tetralin is 11,300 calories per liter, against 7600 for gasoline and 8500 for benzol. Because of its high boiling point, it is impossible to use tetralin by itself, but in admixture with gasoline, benzol and alcohol in various combinations and proportions, it gives very good results in the automobile engine. For example, an equal mixture of tetralin and benzol will start even a cold engine, and there is no difficulty experienced in running the engine with this fuel.

There recently appeared a report of some very informative tests made with a 2:1:1 mixture of benzol, alcohol and tetralin. For the details the reader is referred to Auto-Technik, 1921, Nos. 13, 18 and 19. The engine was of 35 horsepower and the carburetor was of the type used with gasoline fuel. The tetralin fuel gave about 20 miles per gallon, while the same machine got but 12 miles to the gallon with gasoline. The speed reached 55 to 65 miles per hour.

A 1:1:1 tetralin-alcohol-benzol mixture is also a very good substitute for gasoline in running internal combustion engines. The mixture can be used to start cold motors; it does not foul the spark plugs and there is no difficulty experienced with its use, due to the presence of water in the carburetor. The calorific power of this mixture is 8450 calories per kilogram.

At the present time the production of tetralin is not very great, but its development will be fast, as the hydronaphthalenes have other important commercial uses as well. Whether the available supplies of these materials, that is benzol and tetralin, can fill the demands for a motor fuel will depend largely on the development of the by-product coke oven and the use of coke in the place of coal for industrial and household purposes. Eventually, as the petroleum supplies become exhausted, this plan of operation will receive more attention than is accorded it at the present time, although even today there is a movement afoot to educate people to use coke instead of coal.

Concrete Houses

THE use of concrete houses is becoming common in various sections of the country. In connection with the general program for the investigation and improvement of housing conditions now being carried out by the Bureau of Standards, several trips of inspection have been made by members of the staff of that bureau to study improvements in the building of concrete houses. The trip recently made included many projects in the vicinity of Pittsburgh, Cleveland, Chicago and Minneapolis. Great improvements, both in the ordinary uses of the concrete and in the architectural and ornamental effects obtained, were noted on this trip. It seems certain that some style of concrete house will become very common in the near future.

Nelson's "Victory" Makes Her Last Voyage

THE greatest battle of the days of wooden ships was that of Trafalgar—the most noted of the line-of-battleships in that stupendous fight was the "Victory"—and the most famous of the many famous captains and admirals that fought and bled on that great day was the immortal Nelson, who, shot down in the hour of triumph on the quarterdeck of the "Victory," expired a few hours later in her cockpit.

Now all of these things happened over 100 years ago, and an appreciative people have so carefully preserved the old three-decker, that she is afloat today; and this in spite of the fact that her oaken timbers were fashioned and treenailed together over 150 years ago, or, to be exact, in the year 1765. However, the ravages of time and weather tell; and despite all her staunchness, and the loving care with which she has been preserved, the old craft is in a bad way. Hence, it was recently decided by the Admiralty to place her in one of the older and smaller drydocks, known as No. 2, at the Portsmouth Navy Yard, and give the hull a thorough examination. If the bottom timbers are found to be too far gone to permit of the ship remaining afloat, or to warrant reconstruction, the "Victory" will have the little stone dock all to herself as her final and permanent resting place.

When she was docked and unwatered, it was found that much of the copper on her bottom had been displaced, and that there was some decay of her timbers. At the present writing no detailed report of her condition is available. It is to be hoped, because of the fame of the great sailor—a fame that has reached far beyond the limits of the British Navy itself, and is nowhere more gladly recognized than in our own United States Navy—it is to be hoped that the grand old ship may be preserved for many generations to come.

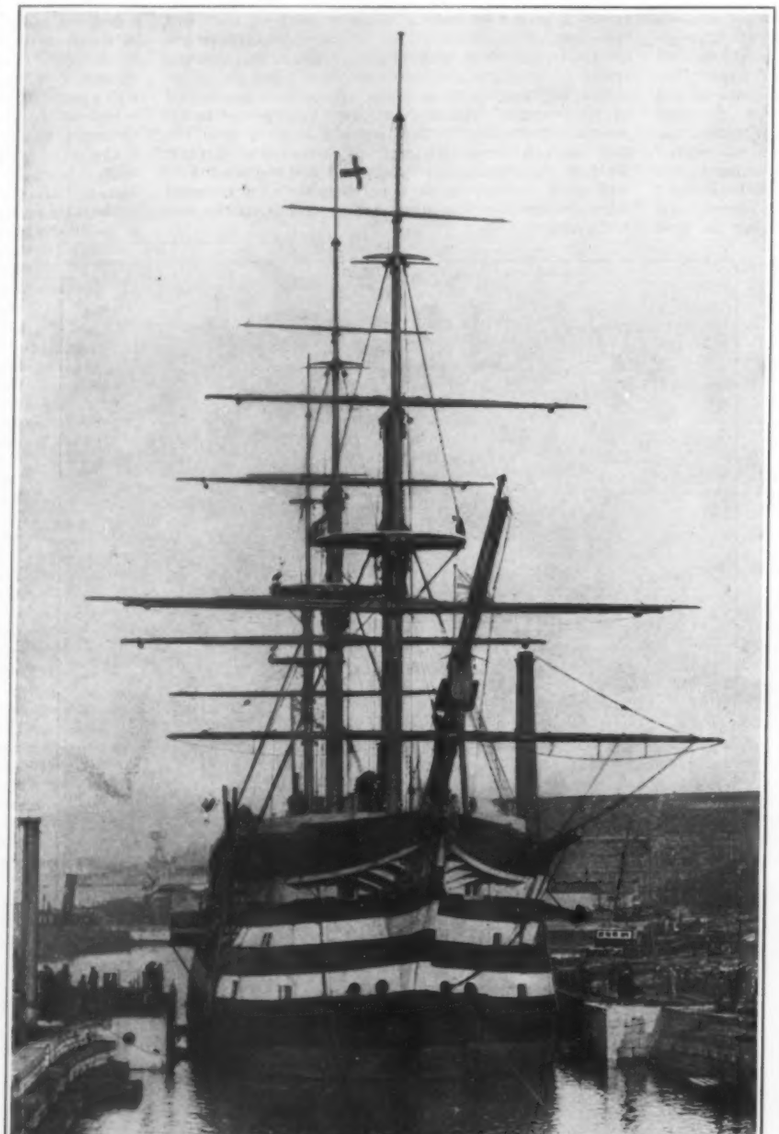
Although the three-decker line-of-battleship of the Eighteenth Century was a dignified, impressive and highly picturesque object, she was not a big vessel, judged by modern standards. Thus, we are told that such ships of 100 guns were, in the year 1720, 174 feet long by 51 feet in the extreme breadth, and that they measured about 1550 tons; and that in 1745, or just before the "Victory" was built, a three-decker was 178 feet long by 51 feet in breadth, and measured about 2000 tons. The latter figures were exceeded in the "Victory," which was 186 feet on the gun deck, 52 feet broad, and of 2162 tons measurement. In the same period the 100-gun ship carried a complement, including officers and men, of about 850.

These ships were built of oak, and, because they were built in the open, and many of them, due to the urgent demand, were built of absolutely green timber, their useful life was often of short duration, some of the ships being unserviceable after 10 or 15 years. This happened, of course, only under conditions such as obtained in our own war, when we were slapping ships together in any old fashion, in answer to the demand for "ships, ships, and yet more ships."

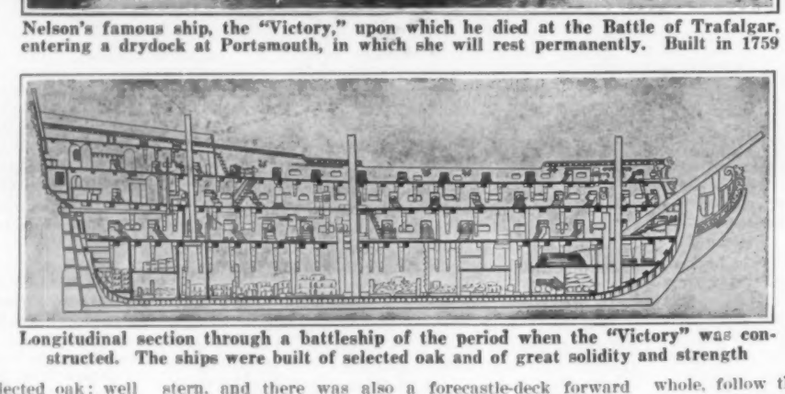
However, when there was no urgent rush, and seasoned timber could be used, these old battleships proved to be exceedingly staunch and of long life, as witness the "Victory," built in 1759. They were constructed of selected oak; well seasoned; and the scantling was to our modern eyes of enormous dimensions. It is a curious fact that the fastening was by means of treenails instead of by metal spikes or bolts. The diameter of the treenails, we are told by Chatterton in his delightful book "Ships and Ways of Other Days," was determined on the basis of one inch for every 100 feet length of the ship. The bottom below the waterline was covered with tarred brown paper over which was nailed a sheathing of thin copper plates.

We show a longitudinal section of a typical three-decker of that date. The guns were arranged in rows along her three decks, the lower gun-deck being a little above the waterline. These decks ran from stem to stern, and there was also a forecastle-deck forward and a quarter-deck aft. Below the lower gun-deck were coiled the huge hemp cables, 720 feet in length and over 8 inches in diameter. Here also were the powder magazines, stores, etc. Nelson painted his ships black with a yellow stripe along each line of ports. A checkered effect was produced by painting the ports black. A "first rate" carried either 32- or 42-pounders on her lower gun-deck, 24-pounders on her middle deck, and 12- or 6-pounders on her upper deck. On the forecastle and quarter-deck were 6-pounders.

The masting and the standing and running gear of an old-line-battleship were on a grand scale; there were no double topsails, nor were there skysails; but the yards were larger than anything used, even in the later days of the Merchant Marine or the era of the clipper ships. One of the largest French battleships carried a mainyard 125 feet in length, and yards of 100 feet were not uncommon. However, because of their bluff model these grand old ships were slow sailers, even with started sheets. It was all they could do to hold their own when on a wind.



Nelson's famous ship, the "Victory," upon which he died at the Battle of Trafalgar, entering a drydock at Portsmouth, in which she will rest permanently. Built in 1759



Longitudinal section through a battleship of the period when the "Victory" was constructed. The ships were built of selected oak and of great solidity and strength

An Injustice to the Krupp Works

THE Krupp works, of Essen, call our attention to a statement in our November issue among the "Miscellaneous Notes," to the effect that they had at the time three howitzers under construction; also to a "Patent and Trademark Note" in the December issue stating that this firm had applied for French patents on eight inventions pertaining to guns, gun mounts, etc.

Messrs. Krupp feel that these items are apt to spread the impression that they are acting contrary to the stipulations of the Versailles Treaty. They accordingly request that we give space to the explanation that at the moment, three 28-centimeter howitzers, which had been purchased from the Krupps by the Brazilian Government before the war, are being mounted at Essen, with the express permission of the Entente and under the supervision of the Interallied Control Commission. Besides these three guns, it is explicitly stated, no war material has been made at the Essen plant since the conclusion of the treaty.

With regard to the patents mentioned, it is pointetd out that necessarily the Krupp firm made numerous inventions during the actual period of the war, and that at the time it was obviously impossible to protect their rights in these inventions in countries which were then at war with Germany. It is the desire to protect themselves in the proprietorship of these inventions that has led to the filing of the patents in question; and the very cogent inference is suggested, that if the Krupps were at present engaged in war-like activity, the last thing they would do would be to reveal this fact by applying for patents in the Entente nations. We are very glad to print this explanation, and to note the careful attention which is apparently being given by the management of the Krupps to the contents of the SCIENTIFIC AMERICAN.

Observations of Star Colors

THE Vatican Observatory has just published four volumes dealing with observations of star colors on Schmidt's numerical scale (modified by Osthoff). Three of the volumes are separate catalogs, based respectively on the observations of Benedetto Sestini, S. J., at Rome (1844-46), with revision by J. G. Hagen, S. J., of Friedrich Krüger at Aarhus, and of Heinrich Osthoff at Cologne. The fourth is an index catalog, combining the results of the first three, and adding the Harvard magnitudes and spectral types. The colors, on the whole, follow the spectral types closely; there is this physiological effect, discussed by H. Osthoff: a bright star is estimated as whiter than a faint star of the same tint; he investigated this by observing bright stars with sectors of various angles over the object glass, and found that it averaged 0.3 color-unit per magnitude. Owing to this effect, the photographic determination of color-index has advantages over the optical method.

Sugars of Great Price

Some Rare Varieties, of Special Uses, Worth More Than Their Weight in Bullion

By James H. Collins

SUGAR at $250 a pound? Yes, it is now on the market for those who want it. Not many people are direct buyers, yet everybody buys it indirectly.

It is called "trehalose," one of the scarcest and most expensive of a very interesting line of products developed in recent years by American chemists—the rare sugars. Put up in little ten-gram packages at $10, its price in gold for that quantity weighs about 240 grains, and ten grams of sugar 155 grains. It is worth virtually one and a half times its weight in gold. Even by the troy pound, it costs more than 12 ounces of gold.

This particular rare sugar was originally known as "mycose," or mushroom sugar, because it is found in ergot, a microscopic fungus. Berthelot, the great French chemist, first prepared it from trehala manna in 1859, and some idea of its scarcity is gained when one knows that this manna, the excretion of an insect found in Persia and Turkey in the form of cocoons, consists chiefly of starch, sugar and gum derived from a species of globe thistle upon which the insect feeds. Within the last two years, it has been found in the resurrection plant that grows abundantly in our Southwestern states. This is the familiar plant sold as a curiosity, apparently dead, but coming to life when placed in water. Containing two per cent of trehalose, American chemists found a more abundant material from which to make it commercially—abundant in the sense that two or three pounds of this sugar yearly will take care of all their customers.

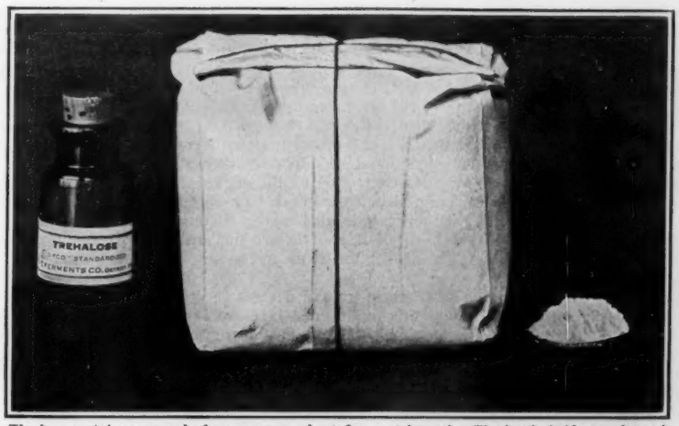
What does the stuff look like—and what is it used for? Just a fine, white crystalline powder, sweetish but not sweet in taste, and, like all the rare sugars, used in the delicate identification work of the bacteriologists.

We all speak familiarly of bacteria. There is the old joke about them being called germs in Germany, parasites in France and microbes in Ireland. However, even to the bacteriologist, the majority of them are invisible under the highest power microscope. If we first think of the infinite variety of plants in a tropical jungle and a botanist turned loose to identify and classify them, and then think of the bacteria as a microscopic and sub-microscopic botanical world, as infinite in its variety, and the bacteriologist turned loose to identify a few thousand of them in one short life—then we get the bacteria into some perspective.

To identify many of them, the bacteriologist must find something upon which they will grow, and they alone, for he cannot see them. Planting his particular bacteria upon some "culture" like one of the rare sugars, which is their congenial garden soil, he raises an invisible crop. Injected into a rabbit or a guinea pig, this culture produces symptoms associated with that particular kind of bacteria and the identification is complete.

Even were it cheap, trehalose would not do for home brew, because it will not ferment with ordinary brewers' or bakers' yeast; but certain wild yeasts are said to ferment in it, and some of those wild yeasts—which are bacteria—may be of great importance to man. If benign, they will perhaps improve his products, enrich his diet, or cure his maladies, and if they happen to be malign, they will spoil his goods, or crops, make him sick—even kill him. A rare substance like trehalose may be the only means by which they can be studied. Because pure trehalose has been almost unobtainable until now, very little bacteriological research has been done with it, and so it opens up a virgin field to the scientific investigator.

You will hardly buy "raffinose" at $150 a pound, or "rhamnose" at $100, or any other of a dozen or more rare sugars ranging down to "saccharose" at $1.35—which is cheap. Because a pound of ordinary table sugar made chemically pure for bacteriological purposes costs $1.50. But indirectly you are buying these products as part of the scientific research work you support as a taxpayer, a contributor, or maybe a patient.



The bag contains a pound of cane-sugar—about five cents' worth. The bottle holds ten dollars' worth of trehalose, and fifty cents' worth covers a half dollar to the extent shown at the right

Sugar—the table variety—versus trehalose

The rare sugars have been developed chiefly through the scientific research of American chemists, and they are entitled to the sole credit for producing them commercially. Before 1914, German chemists had failed to produce them in chemical purity on a scientific scale—some of them they couldn't produce at all.

American research in this little-known field was begun by chemists working for Uncle Sam. Their job, at the outset, was to study problems connected with the production of every-day sugar as we know it in the sugar bowl, and in syrup. With a number of assistants, Dr. C. S. Hudson began this work seven or eight years ago in the carbohydrate laboratory of the United States Bureau of Chemistry. Cane syrup producers in the south were having trouble—people complained that their syrup frequently fermented or crystalized. There is an enzyme known as "invertase," which can be mixed with syrup to prevent that, provided it could be made cheap enough. It is found in many yeasts and other fungi, as well as pollen grains, beet root and other sources. It is a ferment or "enzyme." This work with invertase directed attention to the rare sugars, and the government chemists went after them, passing from the study of practical problems to pure research. Some of the rare sugars were already known as laboratory substances, but methods of isolating them were vague and uncertain. In most cases, they had not been rendered pure, and in no case had they been brought to the point of manufacture and made available for scientific workers. Better methods were devised for isolating these known sugars, and later making them in quantity. Other rare sugars were discovered by members of Dr. Hudson's staff. One young chemistry B.S., who had gone into the laboratory right after taking his degree, found these rare sugars so interesting that he specialized in them, carving out a profession for himself. The government's carbohydrate laboratory published its results and went back to practical sugar-bowl problems, most of the chemists participating in the rare sugar hunt leaving the government service for work far from rare sugar fields. But T. Swann Harding, the young B.S. who found these rare sugars fascinating, kept on seeking ways of manufacturing them, and attracted the attention of a pharmaceutical concern far-sighted enough to undertake their commercial development. Today, Mr. Harding is not only the chief authority in his unique profession, but practically the only specialist in his line—to paraphrase Louis XIV, the profession, it is he!

"It is not a large nor an immensely profitable line yet," he says, "but for whatever it is worth I am it—living proof that a brain, no matter of how low horsepower, will get somewhere in eleven years of specialization."

As an outcome of his work the past three years, the chemical story of more than one rare sugar brought down to date winds up with a reference to his work.

In the sugar bowl is only one member of a large family of organic chemicals, known by the word "sugars." There are dozens of these, and new ones are being discovered every now and then. Like all organic chemicals, they occur in systematic groups, and these groups are named according to the number of carbon atoms occurring in the molecule. Thus a "hexose" is so called because it has six atoms of carbon.

The majority of the rare sugars are rare indeed. They have been made in the laboratory in minute quantities, studied to some extent, but remain chemical curiosities. About fifteen of the rare sugars already have some commercial importance, and others will eventually be added. For rare sugars are constantly being studied chemically and bacteriologically, and new uses found for them every little while. They are in constant demand in the scientific world, though they were never available commercially until two or three years ago.

Ten of the rarest sugars. The group is worth thirty dollars, which would buy a quarter-ton of ordinary sweetener

The first rare sugar studied by Uncle Sam's chemists was "raffinose," which is the second most expensive at $150 a pound. It really consists of three simpler sugars and can be partially broken down to "melibiose," and "levulose," or wholly broken down to "galactose," "glucose" and "levulose." It was first found in a eucalyptus, described by Mudie in 1832. Johnston first made the sugar in 1843, calling it eucalyptus sugar. Loiseau crystalized it from sugar beet residues, calling it raffinose from the French word "to refine" in 1856. Ritthausen isolated it from cottonseed meal in 1884, calling it "gossypose." A year later Tollens suggested that all these sugars were the same thing, and so it proved. Hudson and Harding evolved a method for making it in 1914, and Harding later devised a method of manufacturing it in commercial quantities. At $150 a pound, the raffinose in our cottonseed meal alone would, in one year, more than pay off our national debt, for it is worth $30,000,000,000. But it would cost more than the national debt to extract it, and a few dozen pounds yearly are all the scientific world requires.

(*Continued on page 362*)

Automatic Train Control Made Obligatory

What the Recent Action of the Interstate Commerce Commission Means to Forty-Nine Railroads

By C. H. Claudy

FOR as many years as inventors have claimed to be able to produce a device which will automatically control the speed of a train, or stop it if the engineer fails to see the signal, railroads have contended that the plans proposed were impractical, that they wouldn't work in bad weather, that they were too expensive, that they wouldn't increase safety materially, and that they were unnecessary anyway where block-signals were employed. A similar categorical set of objections has been urged against every revolutionary invention; air brake, automatic coupler, linotype, automatic telephone exchange, etc.

But the old order changeth and giveth way to the new, and the new in this matter is literally an "order" from the Interstate Commerce Commission (dated January 10, 1922) to 49 of the leading railroads of this country to show cause on or before March 15th of this year why they should not be required to install automatic train control on or before July 1, 1924.

In spite of the fine record of some of the railroads, of hundreds of thousands of passengers carried yearly without a fatality, no one seriously questions the fact that American railroads take a heavy toll of lives and limbs every year; and for years inventors have been clamoring that their automatic train control devices would largely decrease such toll. Now we are to see whether or not modern science can stop some of the wicked loss of life; this order of the Interstate Commerce Commission to those enthusiastic over automatic train control appears as bidding fair to be as revolutionary in its results as was the invention of the air brake.

The Interstate Commerce Commission has not been led to issuing this order arbitrarily or suddenly. From 1907 to 1912 the Block Signal and Train Control Board of the I. C. C. has been operating, as a result of a Congressional resolution, and since 1912 the I. C. C. Bureau of Safety has continued such investigations. As a result of 14 years of labor the I. C. C. has come to the conclusion that automatic control of trains is practicable; that the use of automatic train control devices is desirable as a means of increasing safety; and that the development of automatic train control devices has reached a stage warranting the installation and use of such devices on a more extended scale. The successive investigations with their satisfactory results, and the recognized obvious need for some such device, resulted in the inclusion of a section in the transportation act of 1920 which places upon the I. C. C. the duty, after investigation, of ordering the installation by the carriers of automatic train-stop or automatic train-control devices which comply with prescribed specifications and requirements. That section, now section 26 of the interstate commerce act, provides:

"That the commission may, after investigation, order any carrier by railroad subject to this act, within a time specified in the order, to install automatic train-stop or train-control devices or other safety devices, which comply with specifications and requirements prescribed by the commission, upon the whole or any part of its railroad, such order to be issued and published at least two years before the date specified for its fulfillment."

Engineers will understand the difficulty which faced the I. C. C. in promulgating specifications for a device of this kind. Such specifications must be all-inclusive, and yet no one of them must be contradictory of another, either in wording or in results. Not one more specification than necessary must be included, in order that as wide a latitude as possible be given railroads in choice, and yet not one too few must be stated, in order that the device selected be sure to be adequate to the work to be performed.

The definition of automatic train-stop or train-control devices adopted by the I. C. C. is as follows:

"A system or installation so arranged that its operation will automatically result in either one or the other, or both, of the following conditions: First.—Automatic Train Stop.—The application of the brakes until the train has been brought to a stop. Second.—Automatic Speed Control.—The application of the brakes when the speed of the train exceeds a prescribed rate and continued until the speed has been reduced to a predetermined and prescribed rate."

The I. C. C. specifies that all devices adopted must meet certain general requirements: All automatic train-stop devices must be effective when the signal admitting the train to the block indicates "stop," and so far as possible, when the signal fails to indicate existing danger conditions. All automatic train-control or speed-control devices must be effective when the train is not being properly controlled by the engine man, and all automatic train-stop, train-control or speed-control devices must be operative at braking distance from the stop-signal location if signals are not overlapped, or at the stop-signal location if an adequate overlap is provided.

The apparatus of train-control devices acceptable for installation under this order must be so constructed as to operate in connection with a system of fixed block or interlocking signals, if conditions require and so inter-connected with the fixed signal system as to perform its intended function, in event of failure of the engineer to obey signal indications and, so far as possible, when the signal fails to indicate a condition requiring an application of the brakes.

Train control apparatus must, so far as possible, perform its functions if an essential part fails or is removed, or a break, cross or ground occurs in electric circuits, or in case of a failure of energy. Indications of the fixed signal must depend, so far as possible, upon the operation of the track element of the train control device, and the proper operative relation between the parts along the roadway and the parts on the train must be assured under all conditions of speed, weather, wear, oscillation and shock.

THE recent action of the Interstate Commerce Commission in calling upon forty-nine of the leading railroads to install the automatic stop on the sections of their roads where the traffic is densest and most liable to accidents, is one of the most important acts of that body to safeguard the traveling public. Fortunately the practical inventors of the United States have so far anticipated this action of the Commission that there are today several systems of automatic stop which have been made the subject of exhaustive tests on the leading railroads of the country. In view of the far-reaching effects of this ruling of the Interstate Commerce Commission, we have decided to publish a series of articles describing the most successful of the safety-stop systems. The first of these will appear in the June issue.—EDITOR.

The release of brakes after automatic application must be impossible until the train has been brought to a stop, or its speed been reduced to a predetermined rate, or the obstruction or other condition causing the brake application removed; yet it must not interfere with the application of the brakes by the engineer or impair the efficiency of the air brake system. It must be operative when the engine is running forward or backward, and when two or more engines are coupled together, or a pushing or helping engine is used, it must operate on the engine from which the brakes are controlled.

A very important provision requires the apparatus to be so constructed that it will operate under all weather conditions which permit train movements, and of course, it must conform to established clearances for equipment and structures. Neither shall any installation be made that constitutes a source of danger to employees or passengers.

The I. C. C. brings forth very clearly in its report the fact that, while the order will undoubtedly cause a large expenditure of money, there is to be expected a compensating gain of no small amount. For instance, I. C. C. accident reports indicate that from 1909 to 1917, inclusive, 13,339 head-on and rear-end collisions resulted in damage to railroad property alone of over nineteen million dollars and in 2454 deaths and injuries to 37,724 people. During the two and one-half years from January 1, 1918, to June 30, 1920, inclusive, there were 3226 such collisions resulting in the deaths of 635 persons and injury to 6240. Railroad property was damaged seven million dollars worth. If to the large property loss the death losses and the damages paid for injuries be added, the total rises to enormous figures. Had an amount equal to the total losses to the carriers been expended in the installation of automatic train-control devices, many thousands of miles of road could have been equipped.

That the contention made that automatic train control is not needed where block systems, or automatic systems are in use is not borne out by the facts has been strikingly brought out in statistics of the I. C. C. Bureau of Safety for the fiscal year ending June 30, 1921. During these twelve months 62 collisions and 35 derailments were investigated. The collisions resulted in 194 deaths and injury to 849 people. The derailments caused 77 deaths and injury to 518 persons, a total of 271 killed and 1367 injured. Twenty-six of these collisions occurred on lines operated by the block signal and of these 17 happened in spite of automatic signals. Of the 17, 8 were rear-end, 4 were head-on and 3 were side collisions. Of the 17 collisions occurring in block signal territory there were 13 cases in which enginemen, pilots or motormen failed properly to observe or obey signal indications. These undoubtedly would have been prevented had an adequate automatic train control system been in use.

The Interstate Commerce Commission endeavors to meet in advance the arguments which of necessity will be raised against what many will term a drastic order. It will be difficult, indeed, for those interested merely in saving the investment required to answer such an argument as this, quoted from the I. C. C. report on their own order:

"Our investigations have shown that automatic train control has long since passed the experimental stage. In fact, no safety devices such as the automatic coupler, the air brake and the automatic block signal were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted. The fourteen years of investigation and study, the service tests under varying conditions and the results obtained in the actual employment of these devices over periods of years upon some of the roads have clearly demonstrated the practicability of and the necessity for automatic train-stop and train-control."

For the benefit of the few who read this who may not be conversant with modern inventions in this field, it must be explained that the use of automatic train control devices does *not* remove initiative from the engineer. Under the block signal system, the stop signal is mandatory; the engineer has no choice but to obey. It has never been considered that this mandatory command to stop involves any loss of initiative on the part of the engineer.

The automatic train control makes the mandate effective even when the engineer doesn't see it. If he sees the signal, and stops, the automatic train control doesn't operate. If he doesn't see it, or seeing it, "forgets" or tries to "run by," automatic train control takes the train and stops it. The same may be said of speed control. A cautionary signal is often disobeyed; automatic train control will force the engineer to obey it. But if he obeys his signal command without delay, he will not have his train taken out of his hands.

At a street crossing the officer holds up his hand and the child on the sidewalk waits. If the child darts out in the middle of the street, the officer catches it and holds it, to prevent it being run over. Automatic train control does for the train what the traffic officer does for the unthinking pedestrian.

With this order in force, there is but one thing more to be required of railroads to insure real safety in traveling—the compulsory installation of wireless telephones, that no lap-orders on single tracks can ever again take their deadly toll, and that the engineer be in constant, not intermittent, touch with the train dispatcher.

There can be no question that this ruling of the Interstate Commerce Commission, if faithfully and fearlessly enforced, will throw a safeguard around the traveling public, comparable to that which resulted from the enforced application of the block signal, the air brake, and the automatic coupler. Upon some of the railroads, no doubt, it will impose a temporary hardship; but in the long run, because of the prevention of losses of life and property, the measure will no doubt prove justifiable.

Flood and Drought Control on the North Platte

The Pathfinder Project That Will Straighten Out the Water Supply of Southeastern Wyoming

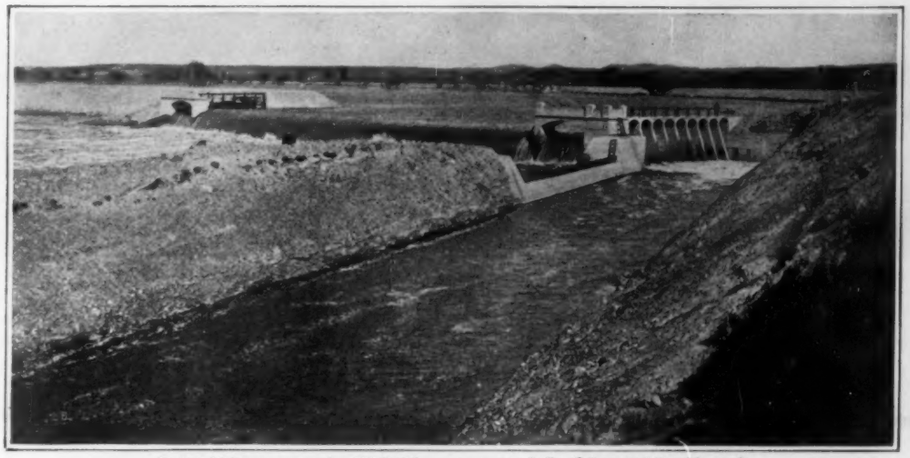
By S. R. Winters

IF the water hemmed in by the Pathfinder Dam, built across the North Platte River, in Wyoming, were to be uncorked there would be a volume sufficient to cover an area equal to the size of the State of Rhode Island to a depth of one foot. It is one of the largest masonry dams in the world. The immense water-retaining walls rise 218 feet above the rock foundation; the dam is 432 feet long, 10 feet wide on top; 80 feet long and 90 feet wide on the bottom; and contains 60,210 cubic yards of masonry.

The watering plan of the North Platte project provides for the storage of flood waters in a reservoir controlled by the Pathfinder Dam, built across the North Platte River, 50 miles southwest of Casper and 100 miles northeast of Cheyenne, Wyoming. It is the second largest irrigation enterprise of the Reclamation Service of the United States Department of Interior, the Boise project in Idaho being the largest. At present, 145,000 acres of farming lands are being reclaimed to productive uses, and once the plans have been completed 252,000 acres of ground will be redeemed to agricultural production. When inventory of this irrigation enterprise was taken on June 30, 1920, the project had already entailed an expenditure of $11,833,000.

The dam and reservoir have cost—up to October 20, 1921—$1,845,000. The reservoir is a receptacle for the drainage of 12,000 square miles. It extends for 22 miles up the North Platte River and for 13 along the Sweetwater River, the artificial "pond" being located at the junction of these two rivers in central Wyoming. The area of this water-retaining tank at the level of the spillway is 22,600 acres and its capacity is 1,070,000 acre feet. The spillway exceeds 600 feet in length at an elevation of 184 feet above the stream bed. The river has an average run-off of 1,400,000 acre-feet at the Pathfinder Dam. Heavy snows in the winter and the subsequent flood waters in early spring may vary this figure considerably. The run-off during one season was 1,000,000 acre-feet in excess of the average run-off.

The Pathfinder Dam takes its name from a tradition that General John C. Fremont, popularly known as "Pathfinder," once passed through the canyon at the reservoir site on one of his exploring expeditions. This deep, narrow canyon is on the North Platte River three miles below the mouth of the Sweetwater River and 50 miles from Casper, Wyoming, the nearest railway station. The Pathfinder Dam is an arched masonry structure, the radius of the center line of the top being 150 feet. Its top is surmounted by a stone parapet or protection wall four feet high and two feet thick on the upper face and there is a pipe railing on the lower face. The height of the top of the parapet is 5864 feet above sea level. The upstream face has a batter of one horizontal to four vertical and the downstream face a batter of one and one-half horizontal to ten vertical. On the north side of the river, with crest at elevation 5850 or 10 feet below the top of the dam, not including parapet, is a spillway 600 feet long. It was cut in solid rock adjacent to the dam, thus permitting a release of surplus water once the reservoir is full. Not remote from the south end of the huge prison for an artificial water supply an earthen dike has been built to close a gap in the wall of the reservoir.



29 feet high; concrete wier 300 feet long; aggregate bulk of dam, 80,740 cubic yards

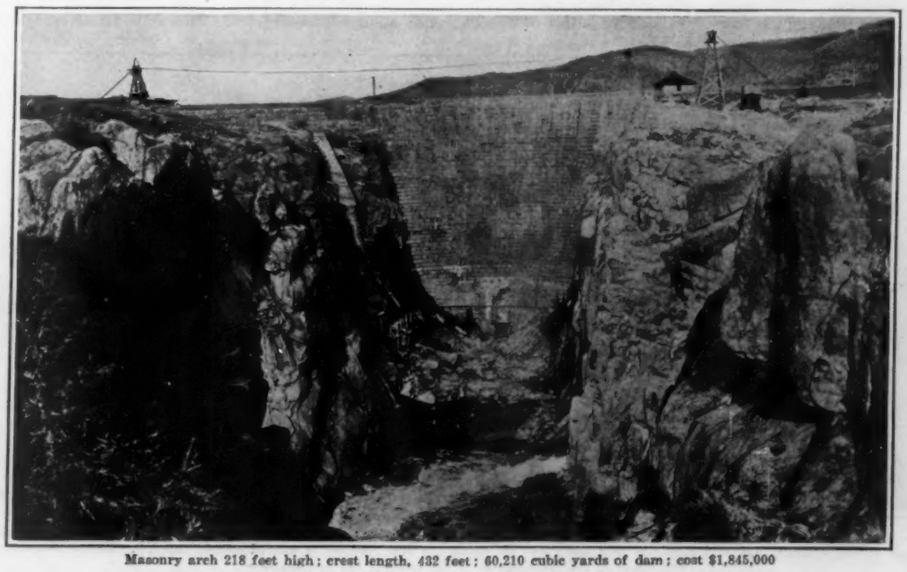
The Whalen diversion dam that divides the North Platte into canals on each side

A curved concrete guide wall extends from the north end of the dam a distance of 108 feet along the side of the spillway to protect the toe of the dam. Also, a bridge embraces the distance from the north end of the dam to the gatehouse above the service gatehouse to that above the emergency gate shaft. Stones on the face of these massive water-retaining walls are squared and faced, being laid in regular courses with horizontal and vertical joints. On the inside of the structure are to be found oddly and irregular-formed stones, some of which weigh as much as ten tons. These rocks are planted or embedded in cement mortar, with concrete filling up the openings between the stones. Horizontal steel bars fortify the upper 27 feet of the dam to a depth of five feet from either face. Two lines of 36-inch cast-iron pipe course through the structure at elevation 5675, or five feet higher than the intake floor of the tunnel, and with floor elevation 5691 there is an opening through the dam the section of which is a square with side of four feet surmounted by a semi-circle with a radius of two feet. Stone employed in building the structure was hard coarse-grained granite, assembled from three different quarries, all located less than one-fourth of a mile from the site of the dam. The face stones, varying from two to three feet in thickness, were placed in courses with joints one to two inches thick. The backing stones—some of which weighed ten tons—averaged four tons in weight and were irregular in size. They were laid in beds of cement mortar. The vertical joints, six inches wide, were filled with concrete in much the same fashion that a farmer would daub the openings in his barn with mud.

Identified with this 218-foot-high masonry dam are two tunnels, respectively 480 and 360 feet in length, through which the penned-up waters are supplied to the river for diversion at points farther down the stream. The discharge is regulated by four high-pressure gates. The latter are of gray cast-iron with the contact portion of the faces covered with bronze strips in order to make easy the sliding arrangement on like bronze surfaces attached to the gate frames. Each gate is 7½ feet long, 4½ feet wide and controls a waterway 7 feet high and 3 feet 8 inches wide. The weight of the gate, including the lifting rod and piston, approximates 10,000 pounds. Immediately above each gate is a recess into which it rises on being opened. Over the shaft is a gatehouse or power unit which contains the machinery for controlling the gates. A feature of this is that, with correct use of the throttle valves in the piping, the oil pressure produced by the pump can be applied to either the top or bottom of the piston and thereby close or open the gate.

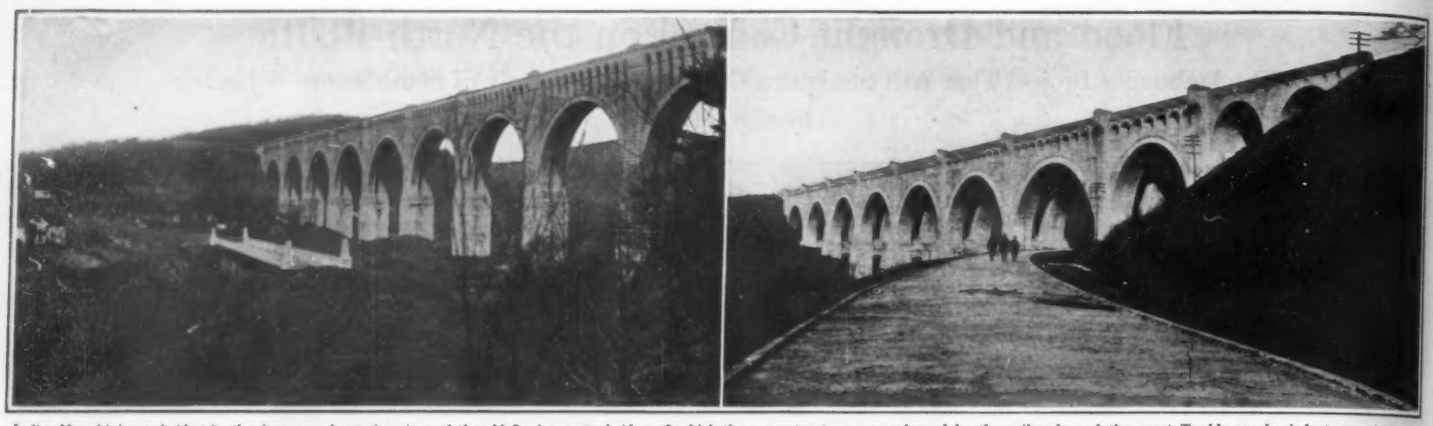
The Pathfinder dike is situated at a gap in the rim of the reservoir one-quarter of a mile south of the Pathfinder Dam. Elevation of the lowest point of the gap is 5832, or 18 feet below the elevation of the spillway of the dam. The dike is an earth embankment 1650 feet long and 20 feet wide on top, with a slope of three to one on the water face and two to one on the lower face. Its greatest height is 38 feet. Twenty-five feet upstream from the center line is a concrete core wall which reaches within 12 feet of the top of the dike or 8 feet above the crest of the spillway. The core wall is built of reinforced concrete, and at its greatest height attains 31 feet. It is 24 inches thick near the foundation and 12 inches at the top, and has a footing 18 inches thick and 5 feet wide resting in a trench 5 feet deep. The upstream portion of this embankment consists of earthy material paved with granite blocks 18 inches thick on a foundation of crushed rock 18 inches thick, and the downstream strip is made of gravelly material.

Farming on this reclamation project will involve the growing of alfalfa, oats, sugar beets, potatoes, corn, wheat, barley, and beans. Such is the diversity of crops nurtured by this sandy loam soil. Dairying may be pursued to advantage, and an abundance of alfalfa, sugar beet tops, pulp and waste from the sugar factory, render inviting the opportunity of feeding cattle and sheep as a profitable business. Aside from this, floods have heretofore been of periodic occurrence in this vicinity; a future safeguard will be present in this silent monarch of the stream. Damages from floods, when thus averted, may be a compensating feature equal or probably in excess of the total cost of this reclamation project.



Masonry arch 218 feet high; crest length, 432 feet; 60,210 cubic yards of dam; cost $1,845,000

Another of the big links in the North Platte control system: the Pathfinder Dam



Left: New highway bridge in the foreground, on the piers of the old Lackawanna bridge of which the superstructure was salvaged by the railroad; and the great Tunkhannock viaduct, on which the track now crosses the valley, in the background. *Right:* Another point where the new and the old meet.

Two views of the Lackawanna Trail, at points where it touches the new line of the railroad

From Railroad to Highway

How 33 Miles of Abandoned Right-of-Way Was Converted Into a Scenic Boulevard

WHAT automobilist has not dreamt of driving over a perfect road with no sharp curves, no steep grades, no railroad crossings, no dangerous intersections and sufficient scenery to occupy the attention of the rear-seat drivers? These specifications are rarely completely fulfilled, but they will be met on the Lackawanna Trail, now nearing completion. The trail lies chiefly in northeastern Pennsylvania and will be the main highway between Scranton and Binghamton. A large part of it is new construction and the rest is improved highway in good condition.

Some 70 years ago a railroad pushed a single track from Scranton northwest toward Binghamton through rugged country, taking advantage of the valleys where possible by winding along their sides. This became the first track of the Delaware, Lackawanna & Western through this region. It proved its value and later it was double-tracked. With the advent of heavier cars and locomotives, operating difficulties because of curvature and the relatively steep grades for a railroad, led the D. L. & W. to reconstruct some 40 miles of the railroad between Scranton and the New York State line, most of it on an entirely new location. The relocation is well known among railroad men as the Tunkhannock Cutoff, features of which were the construction of two of the largest concrete bridges in the world. The new railroad location was put into operation in 1916.

The abandonment of about 33 miles of railroad roadbed at a time when funds were becoming increasingly available afforded an opportunity to give this section a through highway, probably unequalled for light grades and curvature in any similar terrain. For years the roads, so called by courtesy, leading north from Scranton have been the despair of the officials intrusted with their maintenance, and of the unfortunates who used them. These roads, except near the city, are steep, rough, and usually either muddy or rocky. The worst conditions were in the spring, when it was often physically impossible for anything but a light wagon to get through. The opportunity to provide a good through route was quickly seized by officials of the Pennsylvania State Highway Department who, aided by local organizations, obtained the hearty cooperation of the railroad, and for a purely nominal consideration acquired about 33 miles of the abandoned roadbed for highway purposes. This is the major part of the new route between Scranton and the New York State line where it joins an already improved section of the New York highway system leading to Binghamton.

Leaving Scranton the new route follows a steep, narrow valley on existing concrete and macadam roads. At Clark's Summit it turns on to the abandoned roadbed, which it follows except in three short stretches for the next 33 miles—that is, as far as New Milford. From New Milford to Hallstead 5.7 miles of pavement is being laid on an existing highway, and from Hallstead across the New York line to Binghamton there is an existing highway, a good penetration macadam. Between Clark's Summit and Hallstead the trail is entirely new construction. Two types of modern pavement are being laid—namely, sheet asphalt on a concrete base, and reinforced concrete. The new paving is 18 feet wide.

When the old roadbed had been acquired, plans were immediately prepared and contracts were awarded for the two longest sections in the summer of 1919. These totaled 23 miles of the 28 miles of new construction. The following spring two more sections were let, totaling 10 miles, and the remaining 5 miles was awarded early in 1921. All the sections are now well along toward completion.

The most difficult part of the work in many respects is the three-mile section south of New Milford. Here for about a mile it was necessary to construct a location for the highway along a steep side hill, as the railroad had not shifted its line sufficiently to permit a road to be placed on the old roadbed, nor could the highway be built beside the railroad in the railroad cut because the abrupt slope of the hill would necessitate excessive earthwork. The trail, therefore, climbs on to the hill, where it remains for about a mile before dropping back to the old roadbed. This mile is located on a natural bench, the slope of which is somewhat less than that near the foot of the hill. The quantity of earthwork involved was large. It was also difficult to handle because of the danger of blasting or spilling rock down onto the railroad.

Near Nicholson a 405-foot highway bridge has been constructed to replace the railroad bridge salvaged by the railroad when it abandoned its old roadbed. This new bridge consists of three 135-foot span deck-trusses surmounted by a concrete floor and parapets. It rests on the original bridge abutments and piers. Beside it, a few hundred yards away, the wonderful Tunkhannock Viaduct of the railroad, the largest concrete bridge in the world, dwarfs the highway bridge. Paving on the trail adjacent to this bridge had not been undertaken when our photograph was taken.

Between Factoryville and Nicholson the trail leaves the old roadbed to go around a tunnel which it was not considered advisable to convert for highway pur-

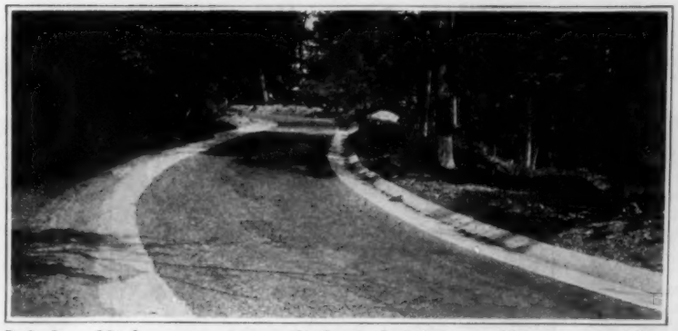
Left: Three levels on one side hill. At the extreme bottom may be dimly made out the new line of the railroad; half-way up the slope, but too close to the new tracks in places to permit its use for the new highway, is the old location of the railroad; and still higher is seen the grade on which the new roadway is carried around this hill. *Right:* Forms, mixer, industrial railway and cars as used in the construction of five miles of the new highway

Converting the old D. L. & W. right-of-way across northeastern Pennsylvania into an automobile highway of concrete and asphalt

poses. No construction difficulties were encountered in doing this, but, of course, it involves heavier grades than are usual on the trail. The principal difficulty encountered by the contractors in constructing the trail has been the difficulty common to all highway construction during 1920, that is, securing, handling and transporting the materials used in construction in quantities sufficient to permit production at equipment capacity. Various methods of handling and transporting materials have been used, such as haul by trucks to stock piles and from these short haul by loaders and tractors to the mixer; stock piling and handling to mixer by wheelbarrow; stock piling in small piles and transferring to mixer by belt loader; batch boxes loaded at a central material plant and handled by industrial railway to mixer; truck haulage in subdivided trucks from central plant to mixer. As the methods were used under varying conditions of haul, grade and efficiency of superintendence, generalization as to the relative value of these methods is subject to criticism. It may be stated, however, that for short hauls, particularly, the industrial system was successful. Especially where it was possible to make some of the haul on the completed base or pavement, trucks were less expensive for the longer hauls, some of which were as long as seven miles. Stock piling on the sub-grade near the mixer is no longer permitted by the Pennsylvania State Highway Department, but the old contracts which were in force when this ruling was made may still use them. A combination of small stock piles of stone handled by loader and tractor for a hundred or so feet of haul to the mixer, combined with sand hauling by shovel from small stock piles into wheelbarrows, proved very effective. The elimination of stone shoveling was a boon to the workmen and seemed to speed up the paving operation where it dragged the most.

One of our figures shows the forms, mixer, industrial railway and cars as used on about five miles of the trail. The track on the right was of 36-inch gage, over which steam locomotives hauled bin cars of materials. This line was the feeder for two paving plants. The bin cars were placed on switches about 1000 feet from the mixers and the materials drawn by gravity into batch boxes on cars of the 24-inch industrial track shown on the left. These cars were pushed by gasoline locomotives to the mixer. The batch boxes were swung over the mixer dropper by a crane attached to the mixer. A section of base, ready for the asphalt surfacing, is shown in the second view at the top of page 316.

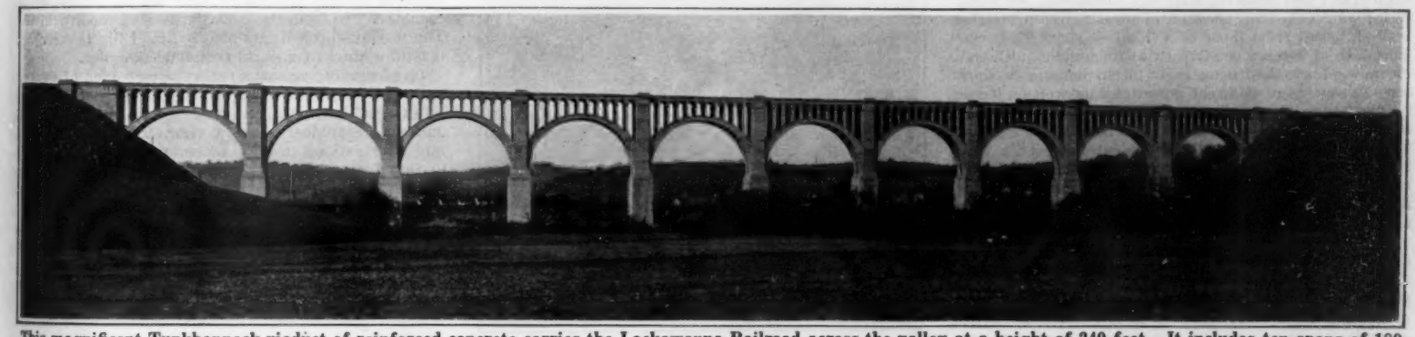
The completion of the trail early next year will open a section of northeastern Pennsylvania which has hitherto been inaccessible to all but the most venturesome of tourists, and will complete a link in what will undoubtedly become a famous tour from New York through the Delaware Water Gap to Scranton, and by the trail to Binghamton, from which point there is a wide choice of good roads east, west and north over the New York State system. The route from the Water Gap to Binghamton will be one of the most scenic in the east, and, what is of equal interest to the motorist, it will be one of the best connected. For the information on which this article is based we are indebted to Col. W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department.



It looks a bit dangerous, to say the least—but fewer accidents occurred here than on the straighter road pictured below

The Motion of the Perihelion of Mercury

THIS question is now of special interest owing to the close agreement between the value of 43″ per century given by Newcomb and the value of 42.89″ deduced from Einstein's theory. Newcomb estimated the probable error of his determination as 2″ per century; but an article by E. Grossmann in *Astr. Nach.*, No. 5115, which comes to us through the columns of *Nature*, reexamines the observational evidence, reaching the conclusion that the actual range of uncertainty is much greater. Newcomb based his result partly on meridian observations and partly on transits across the sun. The difficulties in observations of the latter phenomena are well known, consisting partly in the "Black Drop," and partly in the unsteady image which the sun's heat often produces. There is the further fact that the transits all take place at two particular points in the orbit, and consequently are incapable of determining the motion of the perihelion by themselves; they merely lead to an equation between different secular motions. The meridian observations are also not very satisfactory. They lead in the mean to a distance of Mercury from the sun greater than that corresponding with its period of revolution. Moreover, Herr Grossmann shows that the observations before and after 1850 (about the time when chronographic observation began) have large systematic differences. He finally obtains 29″ and 38″ as the limiting values of the secular motion indicated by the observations. A recent series of observations made with the traveling-wire micrometer of the Cape Transit Circle gave a value very close to that of Newcomb.



This magnificent Tunkhannock viaduct of reinforced concrete carries the Lackawanna Railroad across the valley at a height of 240 feet. It includes ten spans of 180 feet; two of 100 feet; and is 2375 feet in total length

Though it almost appears that human ingenuity could hardly devise a way to wreck a car on this straight, wide-open Maryland highway, the records show that more accidents happen here than on stretches of road that proclaim their dangers with sharp turns and other obvious hazards

Where Road Wrecks Happen

AUTOMOBILE accidents occur more frequently on highways free of curves, steep grades, and railway crossings than on roads where natural danger signals are obvious, if we are to accept with a degree of finality a survey recently made by the Maryland State Roads Commission. The conclusion is that reckless drivers are more cautious in the presence of glaring dangers while on a highway where evident dangers are absent to take a gambling chance with life is a seemingly inviting allurement.

Maryland is perhaps the first State to introduce a system of searching inquiry into the cause for each and every automobile accident within its boundary limits. Daily reports from patrolmen to the chief engineer of the highway system describe any mishap, indicating the exact spot and nature of the accident. The reports afford information as to the character and reason for the accident, whether or not the result was fatal, number of persons injured and killed, and the license numbers of the vehicles involved. Well-defined blanks are provided each patrolman for writing down such information. The reverse side of the blank contains four diagrams of typical stretches of highway. The sections thus represented include a length of tangent, a single curve, a reverse curve, and a cross-roads intersection. The patrolman is thereby enabled to indicate the location of the mishap and tell the distance of the point from the nearest town.

Three months' records, during which time 94 accidents occurred, involving loss of life in 14 instances, serve as a basis for placing responsibility for the cheapening of human life. Speeding is the factor held accountable for 90 per cent of the disasters visited upon motorists. Differently expressed, their own recklessness is responsible for their undoing. And here may be supplied text explaining the significance of the photographs illustrating this article. The road, level as a marble floor and straight as an arrow, free of sinister curves, is a stretch of highway on the National Pike between Baltimore and Frederick, 48 miles of the straightest road in Maryland. Speeding, obviously, has been undertaken with reckless abandon. Sixteen accidents, three of which exacted a toll of life, have occurred within three months. The companion illustration shows a type of road commonly identified with the word danger. Sharp curves, grades, and railway crossings are its recognized tokens conducive to disaster.

The Maryland record explodes this popular theory. In the western half of the State, where the inclines are naturally steep and the gradings curve abruptly, only eight accidents have happened in three months. There was not a single fatality. And we find that the railway grade crossing in Maryland, too frequently the menace to motorists in other States, has not proved to be the outstanding cause of fatalities. A summary of accidents occurring on the State highways of Maryland from May to June, inclusive, is thus represented: Violation of motor law, 60, 10 fatal; wet road, 20, 4 fatal; car trouble, 14, none fatal. The 14 ill-fated accidents are classified as follows: Failure to heed warning at railway crossing, 2; speeding, 4; driving on wrong side of road, 4; reckless driving, 4. Most of these items reduce to "speeding."

The New World

A Review of Dr. Bowman's Book on World Reconstruction

By Albert A. Hopkins

GEOGRAPHY is, or rather was, up to the time of the war, a somewhat neglected subject. True, we had excellent geographical societies, geographical reviews and books on every phase of the subject, still the popular imagination was not stirred at all, and it took the World War to break down the barrier and make the noble science of geography tie into everyday life. The war stopped not as suddenly as it began perhaps, but quickly enough to stir us to the depths. To us in the United States we felt a relief that the carnage was ended and that the pouring out of treasure was almost at an end, but we did not realize that war brings in its train evils which are hardly less acute than actual warfare, barring, of course, loss of life and limb. Our whole system of education unfitted us for the task of helping to reconstruct a bleeding and unfortunate world. Our century-long and uninterrupted success in territorial expansion (for our house is of very thin glass), the high and false values set upon material wealth, together with our political affiliations, increased the difficulties of a time beset by perils of a new order. We had been living behind brick walls in a kind of enchanted garden, a garden which watered itself, a weedless garden and a garden into which rubbish was seldom if ever thrown. Suddenly after the collapse we found that our brick wall had disappeared over night and that our garden had no protection. In America we have never had a trained and permanent foreign-office staff; and however lofty our intentions, we work, so far as scholarship goes, on administrative principles little different from those of a hundred years ago. Our ignorance of foreign countries was unbounded, although the newspapers had done their bit in helping to show certain aspects of political geography as well as battle areas. There was one place, however, where the midnight oil burned always even in its more prosaic form; this was the American Geographical Society in New York where the great collection of maps and books was under constant guard of soldiers, police and detectives, for no chances were taken with this material which was to lend itself to such good uses.

One day after the armistice when all eyes were directed to Paris, three army trucks drove up to the building on upper Broadway and took away 5000 books and untold maps to the waiting steamer. This material might have been valuable in itself, but it needed one who could unlock the key to the riches, and this was furnished by Dr. Isaiah Bowman, the Director of the American Geographical Society, who spent many months in Paris as special geographical expert to our government, with the title of "Chief Territorial Adviser," during the long period of negotiations. After Dr. Bowman returned he decided to put on record, not only in the form of words but in the form of maps, an imperishable record of what the war really meant to the world, for there is not a man, woman or child in any civilized country, and in some uncivilized ones as well, who is not affected to a greater or less degree by the war. To provide the background of information which the average citizen needs to understand the main international questions of our time has been the aim of Dr. Bowman in "The New World" which is issued by the World Book Company in sumptuous form. The author has given this book as a contribution to geographical knowledge without material advantage to him, as all the beautiful maps could not have been supplied by any publisher without the author's generous cooperation, and so we must look up to Dr. Bowman as a real benefactor to geographical science.

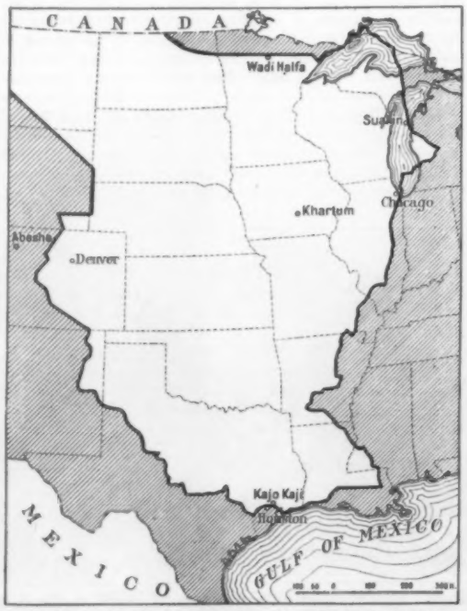
The major problems of the new world are many and complex, and are not likely to be settled in our time. The qualities of selfish ambition and envy are deep-seated; they will pass away only when human life itself is extinguished. So long as they exist there will be war, with its subsequent effects upon political, social and economic life. Almost every event of our time has its counterpart in history. Each age has had its grand catastrophe, its great war, and we are now the victims of the greatest of them all. Like the vast geologic eras of earth history, the new age dates from a period of general change in habit of life. Our political and social environment has been revolutionized. We now look out upon world problems and alien peoples, almost unknown to us until yesterday, in a spirit akin to that of Europeans four centuries ago, when they stood at the threshold of the Age of Discovery. Some of the new world problems are as follows: Can the new world be set going in an orderly manner; how much of the old world

Anatolia and Arabia in terms of American locations

is left; what new boundaries, concessions, colonies, mandatories, spheres of influence and protectorates now appear on the map of the world; what kind of people compose the new states; will the democracies survive—

Why Japan wants room. A typical Japanese village with farms on every hillside

Poland, Jugo-Slavia and Austria for example; what elements of economic strength and weakness has each of the new states, and also each of the old states whose resources have been either increased or diminished by treaty; how will the large and powerful states meet their new rights and responsibilities; can the grip of the powers in "protected" or "occupied" regions (this means us also, Santo Domingo) be loosened without anarchy following; can burden of armaments be reduced; has the day of deliverance come for the oppressed minorities of the earth; how far can the protection of minorities be carried; will strong nations continue the struggle for the trade privileges, raw materials, and strategic zones, with the prospect of war between them if they cannot realize their commercial and political ambitions otherwise? In short, will the changes in the political and economic geography of the world spell peace or war, strength or weakness, in the years immediately before us? These are vital problems for every nation. By reason of some of them war may come, not in a generation, but in a few years. The danger spots of the world have been greatly increased in number, the zones of friction lengthened. Hatred has been intensified by the cruelties of war, an orderly world has been turned into a disorderly one, and we are trying to put the pieces together and they do not all fit. Dr. Bowman has given us the dissected pieces and we can, with the aid of his maps, make a fairly good *vraisemblance* of what it should look like in a short period of time. This is a subject and this is a book which should interest everyone, for no American, however secluded his life, however distant his home from the big cities and the coasts, is free from the consequences of the World War. The world is broken; its international life is disrupted; it is in a state of general economic disorder.



Anglo-Egyptian Soudan projected on the United States, 230 miles of railway in this territory

The foregoing remarks really give an idea of the book which develops theme after theme with a rare insight into the subject both from an economic, an ethnographic and a geographical point of view. There are 280 maps and illustrations, mostly maps, which are beautifully executed from the best sources, rendering them very authentic. It is really a geography or atlas like none other in the world, and as an example we give two of them. We hear very often of the Anglo-Egyptian Sudan as if it were something like Rhode Island, Long Island or Block Island. Now, here it is projected on the United States. Is it any wonder that there are immense difficulties in managing such a vast territory in the heart of Africa, with only 230 miles of railway. At Paris they wanted us to "have" the Mandate of Armenia. Fortunately we had the good sense to refuse. Look on the map of Arabia and see what a mandate over this kind of country would have meant. All our other troubles, the Philippines, turbulent little Porto Rico, Santo Domingo, Nicaragua, Panama, would be as nought compared with this enormous stretch of seething territory, in the midst of which troubled Armenia is found. We are apt to sit down and very virtuously talk about the aggression of England, the imperialistic tendencies of France, Fiume and Italy. Here are the facts: since 1898 the United States has extended its influence and control more rapidly than any other great power, even imperial Russia amounting to 281,044 square miles and 17,598,750 population—all this in nineteen years. The tendency to expansion is very marked, yet we cry out with true Pecksniffian fervor if Japan wants her children's rice bowl filled, and, by the bye, here is a picture from the book showing a Japanese village, and how every inch of ground is utilized to grow something. The whole book preaches a sermon against selfishness, not of the individual but of the nations. We have a long and a hard journey to travel, and this book shows some of the pitfalls and some of the milestones of progress, which we must pass if we wish to reach the summit of the mountain from which we can view the "New World."

Percentage of Home Ownership in Cities of the United States

BASED on the figures of the Bureau of Census, the Bureau of Standards of the Department of Commerce has completed a chart showing graphically the percentage of home ownership in 1920 in cities of the United States having a population of over 100,000. In addition to the chart, tables are included which show the corresponding percentages for the years 1910 and 1900. In 1920 the lowest percentage of home ownership in the country was in New York City, where there were 1,278,341 homes, of which but 12.7 per cent were owned by the occupants. At the other end of the list is Des Moines, Iowa, with 31,644 homes, 51.1 per cent owned.

The Submarine Artist

Waterproof Paints and Canvas and a Diver's Suit Applied to a New Phase of Art

Painted in their native element: Queer fishes of the South Seas—from an oil sketch done under water off Tahiti

ONE of the most curious manifestations of artistic talent has been recently accomplished abroad by a landscape painter Mr. Zarh Pritchard. It is impossible for us to term the product "landscapes" or even "seascapes" which is a well-known term for seashore pictures. Perhaps we can find an expression which outlines Mr. Pritchard's technique, for he paints literally at the bottom of the sea, if the sea is not too deep. He is only limited by the depth which a diver can descend. Perhaps the word "undersea-landscapist" would fill the bill. The ordinary methods and materials must be thrown in the discard when this extraordinary artistic procedure is considered. We are indebted to our excellent contemporary *The Illustrated London News* for the pictures presented and for the idea of the cover which is worked up from a copyrighted drawing made especially by W. R. S. Stott for the beautiful English periodical named above. Our Mr. Howard V. Brown has caught the spirit of Mr. Stott's monochrome, and has translated it into a blaze of color on our cover.

This new idea is one which will not probably be popular with our art students, as few indeed would have the endurance or the means to try such a unique avenue of expression. Mr. Pritchard works at depths ranging from 16 to 50 feet. He is clad in the most approved diving costume with the usual lead-loaded shoes to keep him on the bottom and the usual signal ropes and air-hose. He descends slowly through the water, as we have all seen in the movies, and after carefully exploring the territory near where he lands he selects a comfortable rock, not looking for a dry one as he would probably do on land. He then pulls the rope and down come the easel and the box of colors. Of course the colors are specially prepared and ground extra thick in a special way, and the canvas is also waterproofed or otherwise treated with linseed oil so that the water will have no effect on it. Then he blocks in his outlines and proceeds to lay his tints and finish the whole roughly.

It must not be supposed that an ordinary seashore resort would lend itself to this means of painting. In fact there are only certain places where it would be of any avail. Bermuda, Tahiti, the Saragossa Sea and many parts of the Mediterraneau, and almost any "coral strand" would furnish the raw material. These pictures are regarded as so important than an exhibition was recently held at the Galeries George Petit in Paris. Several of them were purchased by the Prince of Monaco, who is an oceanographic expert of the first magnitude.

Mr. Pritchard has always been fond of diving, and in his youth his favorite pastime was diving. In the bay of Portobello in Scotland he would remain under water weighted down by a bag of sand. It was then that his eyes were opened to the fairy wonders of the ocean floor. But it was in Tahiti that he first donned a diver's costume and made his first descent to a distance of 65 feet. He was obliged to rise to the surface after about a half hour owing to cold or fatigue from the pressure of the water. He often left his painters' materials at the bottom, and we dare say many a fish has had indigestion from such colors as emerald green. Sometimes he even left them overnight as there are no currents among the coral reefs.

For the benefit of our newspaper friends we may state that the copyright in these weird productions is strictly reserved by the artist who has kindly allowed us permission to use them through our excellent English contemporary referred to above.

From an oil painting made at a depth of 32 feet under water: The base of a basalt cliff off the Scottish coast

Moth-Proof Wool

WITH all of the many virtues of woolen fabrics for the making of garments they have one annoying quality in that they present a tempting titbit for one of the worst insect pests which afflict mankind—namely, the ordinary clothes moth, which finds nothing edible in cotton, linen or silk, but dotes on wool. The announcement made a few months ago by a German firm that they had perfected a treatment for woolen fabrics, making them absolutely moth-proof, is of the highest importance, since it presents an opportunity for the prevention of what are at present enormous losses from this cause.

The treatment is extremely simple, since all that is needed is to place the woolen goods in a cold solution of the new chemical until thoroughly saturated. It is then taken out of the solution, hung up for a few hours, carefully rinsed with fresh water and dried.

Woolen goods thus treated are absolutely unappetizing to the greediest moth larva. This was conclusively proved by various experiments. Photographs of two pieces of flannel exposed to moths, one of which was untreated while the other had been dipped in Eulan F., showed that the former was riddled with holes while the latter was untouched. Again a few strands of wool were placed in two test tubes within which moth eggs were then placed. Six months later photographs showed that tube A, containing the untreated wool, was quite empty except for the excrement and pupa cases of the larvæ, while tube B contained the woolen contents intact, plus the corpses of the larvæ, which had quickly starved to death upon issuing from the eggs.

The circumstances which led to this valuable discovery are unusually instructive, showing as they do that an alert mind is stimulated by a mere suggestion which would bear no fruit if it fell upon less fertile soil. Dr. Ernst Meckbach, writing in *Die Umschau* (Frankfurt) concerning this discovery, which appears to be due chiefly to his own researches, tells us that

From a painting made at a depth of 50 feet in the South Seas: Coral towers at the bottom of the sea off Maraa, Tahiti

he was instigated to the latter through the circumstance that he frequently heard housewives ripe in years remark sagely, "Moths won't touch green cloth." This struck him as so curious that he began to experiment, with the result that the moths ate the green stuff as eagerly as that of any other color. It occurred to him, however, that the green dyes of modern use might be different in character from those used in earlier days. Investigation proved this theory to be correct. It was found that green cloth dyed some 50 years ago actually is moth-proof. Strange to say, however, it is not the green dye which is distasteful to the insects, but a certain yellow dye—the well-known "Martius yellow," one of the first of the artificial dyes made from coal tar. The reason for the use of this is that nearly all green dyes are blue-green, so that yellow dye is commonly added to them to alter the shade. It was the Martius yellow thus employed which rendered the fabric safe from the attack of moths.

Pointed rocks at the bottom of the sea: A submarine "landscape" from a study in oils painted 16 feet under water

Transmitting Power in Fluid Waves

Further Details About a System Already Mentioned in a War-Time Connection

From Our British Correspondence

WATER is popularly termed "incompressible," and we have no doubt that many of our readers accept this statement literally and absolutely. It is true enough that water is compressible with difficulty, that beside other fluids it is relatively incompressible. But the idea that it is not to be in any smallest degree compressed calls for a state of mind similar to that of the Greeks who talked learnedly and disputatiously about "irresistible forces" and "immovable obstacles."

Suppose we have 150 meters of ordinary wrought-iron piping, of 2.5-centimeter diameter and ½-centimeter wall thickness. Suppose we force a fluid-tight piston into this pipe under a pressure of 35 kilometers per square centimeter. If we imagine the water to be absolutely unaffected by this pressure, the walls would expand sufficiently to permit the piston to enter 1.5 centimeters. If we imagine the walls to be absolutely inexpansible under this pressure, however, the compressibility of water is such that the piston will enter 26 centimeters. Negligible as it is in ordinary hydraulic practice, this compressibility of water is sufficient to lead to hope for a useful application.

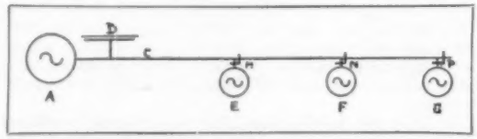
In 1917 rumors reached this country of a new system of power transmission by compression waves in columns of water. Not, however, until our issue of May 17th, 1919, was it possible for us to present anything approaching a satisfactory account of the so-called CC-gear for shooting a machine gun between the blades of the revolving airplane propeller. A more coherent general statement of the new transmission scheme appeared in the SCIENTIFIC AMERICAN MONTHLY for December, 1920. Only now is it possible to discuss the system in full detail.

Wave transmission was first visualized by George Constantinescu in 1914. Mathematically, it is simple and effective; practically, many difficulties and prejudices have had to be overcome. The procedure consists in the setting up of wave motions or pulsations in an enclosed column of liquid, usually water, which is contained in a pipe connecting the wave-generating apparatus with the point of power application. Where ordinary hydraulic transmission depends upon the degree of incompressibility possessed by water, the wave system utilizes the very fact that water can be slightly compressed, and only slightly. The generator sets up pressure impulses in the column of fluid. There is no continuous flow; the liquid particles merely oscillate back and forth between two extreme positions. A wave of pressure traverses the tube and gives up, at the far end, the energy that put it into being.

Consider a column of liquid of considerable length, enclosed in a tube. Let us imagine it under a moderate steady pressure; in addition let us suppose that rapid blows, 40 or so per second, are being delivered against one end of the column. The only resistance to these blows is the inertia of the fluid; and if the column be short, it will act as a solid mass. If it be of considerable length, however, the motion of those layers of the fluid near the impelling piston will be resisted by the inertia of the more remote layers. Compression will result; and there will be a point in the liquid column at which, on the completion of the instroke of the piston, no movement of the liquid will have occurred. Without going into further details, it will be seen that we have here a condition that determines the wave-length of the disturbance that is propagated through the fluid—or, better, its half wave-length. The wave-length will actually be the quotient of the wave velocity in the medium, by the period of the piston. The velocity is found to be substantially that of sound—in water, 4800 feet per second. Experiment and commercial development have employed for the most part a period of 40 cycles. This means a wave-length of 120 feet. The wave is a simple and symmetric one, represented by an ordinary sine-curve.

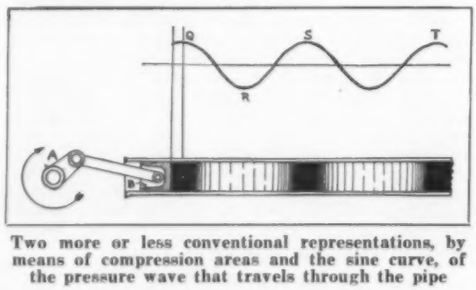
Suppose the pipe is an exact multiple of the wave-length, and is closed at the far end. When the compression wave reaches this point it will be at a crest; and reflection will bring it back to meet the following waves crest to crest and trough to trough. It will continue back to the starting point in this way, with the result that a compression wave of double the original force traverses the pipe. This piling up will go on without limit until the pipe is ruptured by a force greater than its tensile limit.

We must not, then, have the far end of the pipe closed. Indeed, in any event we should want there a floating piston, to take up and convert into work the energy of the waves. But when this piston is not doing work which enables it to take up all this energy, the conditions leading to ultimate rupture are again present. Means must be provided to prevent this before we have a practical system.



Diagrammatic scheme showing arrangement of wave-generator and motors

This means is simple enough. A receiver of generous size, compared with the displacement of the driving piston, opens off the line at a point near this piston. Initially it is full of the fluid. At each instroke a flow will take place into the receiver and its contents will be compressed; at each outstroke the compression will be relieved. The receiver will thus act as a spring, taking up the energy of the direct and reflected waves when the pressure is high, giving it back when it is low. The mean pressure in line and receiver will, however, be the same; so when reflection of waves through



Two more or less conventional representations, by means of compression areas and the sine curve, of the pressure wave that travels through the pipe

the pipe has produced an amplitude corresponding to this mean pressure, the piston will merely exert energy in compressing the liquid in the receiver on its instroke, and the receiver will restore this energy to the fluid on the return stroke. So when the reflected waves have been built up to the proper pressure, further building up will cease and there will be a series of stationary waves in the pipe. There is close analogy here to an electric generator running "light."

We have here the elements of successful commercial operation. A is the generator; D the receiver or "capacity"; E, F and G motors at distances from A of one-half, three-quarters, and a whole wave-length. If the cocks M, N and P are all closed, no energy is absorbed, because of the capacity D. If P be opened, G will absorb some or all of the energy given off by A. A traveling wave will traverse the line. Only when P is closed and another cock is opened will there be any stationary wave in the pipe—from E or F to G. Since it is only with a stationary wave that there occur nodes or points of zero pressure-variation, motors may be connected effectively at *any* point of the line, not merely at exact quarter-wave-lengths.

It is plain that wave transmission bears a distinct resemblance to alternating current; in fact, directly equivalent terms exist in the two systems—period, phase, capacity, amplitude (current) and pressure (voltage). Internal resistance to vibration of the liquid is equivalent to electric resistance. Sympathetic communication of wave energy through the pipe walls occurs and is akin to resonance. If a large mass of heavy material be inserted in the line we have a reactance which will set up inductance or lag. A "capacity" sets up a lead and opposes this reactance. A transformer would consist of two pistons of different diameter, connected by fluid. And we might pursue the analogy further.

The generator now on the market consists of two plungers actuated by a revolving crank. Each down-stroke compresses the water in the system about one-half per cent, by means of a plunger displacement of about 20 millimeters. The momentary pressure of the simple, unreinforced wave is 1600 pounds per square inch. The actual pressure at the summit is 1700 pounds and at the trough 100 pounds, the latter pressure being maintained in the system by auxiliary pump. This minimum pressure eliminates air troubles, since it is quite essential that the system be free of air. Each plunger has its own cylinder and its own "capacity."

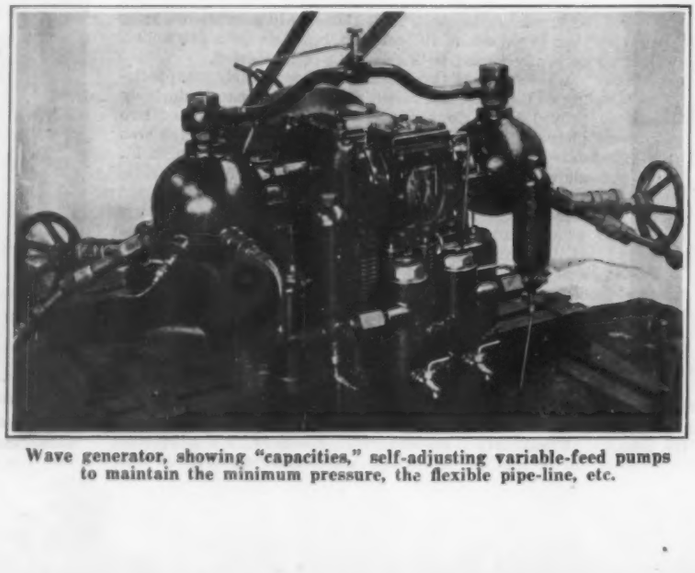
The generator is so free from vibration that when at work a coin may be balanced edgewise on it. Belt driving is permissible, but direct-coupled drive without intermediate gearing is preferable when a power unit of appropriate speed is available. It is necessary to have governing within about 5 per cent when the transmission line is up to 300 feet; when it is longer, the generator speed should be more constant than this. Two or more generators can be run in parallel, supplying power to a single pipe line.

The simplest application is to rock drills and riveting hammers, where the piston is used as a floating hammer and strikes directly on the shank end of the drill or rivet snap. The efficiency of a wave-transmission drill is as high as 50 per cent, whereas a compressed-air plant for mining work will show but 10 per cent. In addition to the direct saving in power thus effected, the wave-power plant is simpler, takes less space, and is altogether more economical than the compressed-air one. A noteworthy point about the wave-power drill is that it is rotated every blow, even though these take place at the rate of 40 per second. This is accomplished by a subsidiary motor actuated by wave-power and in absolute synchronism with the percussive motion. Compressed-air drills have not this action, nor can they be cooled by a water supply at high pressure on the drill point unless additional apparatus be attached.

When a rotary motion is required a three-phase gear is generally used, both generator and motor having three cranks set at 120 degrees. A wide range of flexibility obtains here, however.

Difficulty was experienced by the pioneers of this system in designing suitable transmission piping. For straight runs ordinary hydraulic piping does nicely, but for flexible piping new invention was necessary. The result is highly ingenious, consisting of short lengths of straight metal tubing united by a spherical joint. This is a piece of metal, usually steel, with a spherical recess at each end. In this fit the straight lengths of solid tubing, by means of a ball piece and spherical packing. A spherical-seated nut screwed into the double socket completes the arrangement. The pipe will stand the

(*Continued on page 362*)



Wave generator, showing "capacities," self-adjusting variable-feed pumps to maintain the minimum pressure, the flexible pipe-line, etc.

America's Debt to the Howe Truss Timber Railway Bridge

FEW people, if any, outside of the engineering profession appreciate the debt which we in America owe to a certain highly efficient type of wooden bridge which was used most extensively in early railroad building in the United States.

We refer to the Howe truss timber bridge and its first cousin, the lofty timber trestle, without which it would have been quite impossible so quickly to connect the Far West and the Pacific coast by means of the pioneer railroads of the middle of the nineteenth century. Had the United States not been so abundantly supplied with forests of excellent constructive timber; and had it therefore been necessary to bridge the rivers and canyons of the west with steel structures, the progress of our transcontinental roads would have been greatly delayed and their cost in some cases raised to impossible figures.

The Howe truss bridge, as will be seen from the accompanying photograph of a timber bridge over the McKenzie River on the Southern Pacific system, is a very simple structure containing a minimum amount of iron or steel. The top and bottom chords, which are parallel, consist each of four sawn but undressed timbers, assembled on edge and spaced a couple of inches apart with separating blocks of wood between, and securely bolted together to form a compact whole.

The diagonal members consist of square, or approximately square, timbers, assembled in pairs and bolted together at their centers; and the vertical web members consist of a series of threaded, round iron bars, extending the whole depth of the truss, and secured by nuts on the top and bottom faces of the chords. The end of each diagonal member is cut square or normal to its axis, and these ends bed against triangular cast-iron blocks, whose faces have been formed at the correct angle to provide a fair footing for the ends of the diagonals. The longitudinal component of the thrust of the diagonal members is transmitted from them to the chords by means of continuous, transverse and vertical lugs and legs of square section, which are let into the inner faces of the chords. Two complete systems of wind-bracing run from end to end of the bridge, one for the top chord and another for the bottom chord. There is also a system of sway-bracing, introduced between the diagonal members throughout the bridge.

The excellence of the Howe truss for pioneer railroad building consisted in the two facts that it called for a minimum amount of iron and that the whole of the timber could often be found in the pine or fir forests through which the railroad was being built. A bill for the round iron rods was sent to the eastern steel mills, and then a portable sawmill and a gang of bridge carpenters did the rest. These bridges were simple, easy to frame and rapid in construction and erection. Once put up, their term of life was limited only by the care with which they were inspected and decayed timbers replaced.

The majority of these remarkable bridges were probably from 75 to 125 feet in length, but where necessity called for it, the bridge engineer of those days did not hesitate to build in lengths of 175 to 200, and even, as in the case of the Southern Pacific bridge here shown, 250 feet. Evidence of this may be seen in the accompanying list of long-span Howe truss bridges, which at one time or another were in service on the Pacific system of the Southern Pacific Company.

Colorado River, at Yuma	195	feet
Kings River, at Reedley	192	"
Los Angeles River, at Los Angeles	202	"
Sespe River, at Sespe	192	"
Salinas River	192	"
Alameda Creek	193	"
American River	191	"
Truckee River—1st Crossing	204	"
Truckee River—4th Crossing	204	"
Willamette River, at Harrisburg, two spans of	200	"
McKenzie River, at Coburg	250	"

For these particulars we are indebted to Mr. W. H. Kirkbride, Engineer of Maintenance of Way and Structures of that company. These spans have now been taken down, but the company still has three bridges of 200-foot length in service.

A remarkable fact about the Howe truss bridge was its ability to hold up in the face of long neglect. If so neglected they would sag, but rarely did they break down. In fact, the present writer, during many years of service on western railroads, failed to meet with any case of total collapse. To anticipate and counteract the sagging, a new span was always built with a slight upward curve or camber.

A 250-foot wooden railroad span over the McKenzie River. This type of timber bridge made early Western railroads possible

Facts Concerning Molybdenum

THE United States possesses the largest known deposits of molybdenum ores, but is relatively poor in high-grade deposits of some other important alloying elements used in alloy structural steels, such as automobile steels, says the Federal Bureau of Mines. Nickel, chromium and vanadium are the standbys in present-day alloy steels. Of these we have very little nickel; some chromium, mostly in relatively low-grade ores; and only small deposits of vanadium. It is of utmost importance to know to what extent molybdenum can replace any of these elements. Moreover, there is as yet comparatively little market for molybdenum.

According to tests made by H. C. Chandler and C. H. Willis, given wide publicity by producers of molybdenum, that element as an alloying material ranks with nickel, chromium and vanadium in preparing steel of high quality. Molybdenum steels found some use during the war, but their production thereafter almost ceased.

In order to corroborate the published tests, to extend them and to study in detail the shock and fatigue-resisting properties of molybdenum steels, a cooperative agreement was entered into by the Bureau of Mines with the Vanadium Corporation of America, producers of molybdenum, by which the services of R. J. Thompson, metallographist, were made available. The cooperation of the Wyman-Gordon Co., Worcester, Mass., was enlisted in making impact and repeated-impact tests.

A comprehensive series of molybdenum steels, and of other steels for comparison, has been made in the electric-furnace laboratory of the department of chemistry at Cornell University, and rolled at the Halcomb Steel Co. plant, and test bars were machined, heat treated and given tensile and fatigue tests in the shops and laboratories of the Sibley School of Mechanical Engineering at Cornell University.

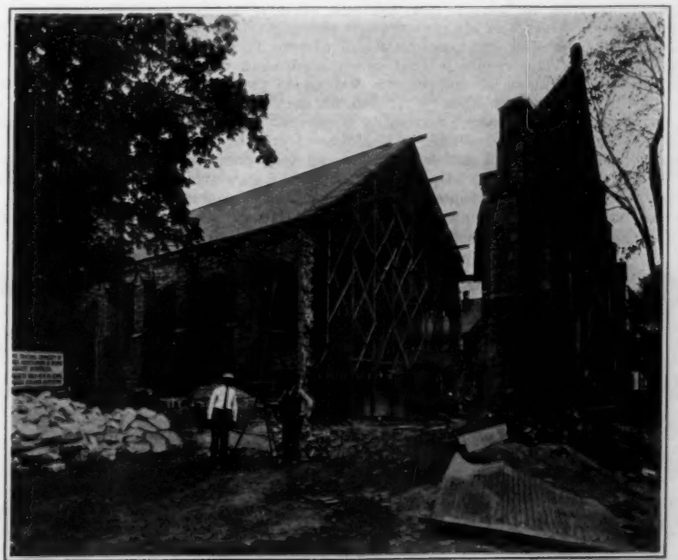
These investigations are well under way, though much of the fatigue-testing work remains to be done. Since it was begun a good deal of information, all favorable to molybdenum steel, has been published by steel makers, but very little has been published on impact tests and nothing on fatigue tests. This work should add materially to the knowledge of the properties of these steels.

Cerium compounds are a by-product of the gas-mantle industry. They find limited use as an ingredient in the cores of flaming-arc carbons and, reduced to metallic forms, in the pyrophoric alloys used in cigar lighters. In order to study the effect of cerium on steel and non-ferrous alloys, a cooperative agreement has been made by the Bureau of Mines with the Welsbach Co. The work on cerium steels has been carried along with that on molybdenum steels and in a similar manner. It has been established that cerium can exert a desulfurizing action. There are, however, some difficulties in the preparation of these steels, and no final conclusions can yet be drawn as to their value.

In the work on special alloy steels conducted at the Ithaca, N. Y., office of the Bureau of Mines, situated at Cornell University, under the direction of H. W. Gillett, chief alloy chemist, the cooperative work with the Navy has been completed, and considerable progress made in the investigations on molybdenum and cerium steels.

In the past fiscal year the work done on the preparation of zirconium and other steels for the Navy was mainly analytical, and was performed for the most part by Lieut. R. McLane and Lieut. J. P. Jenkins, of the Navy Department, working with the advice of Dr. E. L. Mack, of the Ithaca office.

The data on recovery and segregation of various alloying elements in steel has been incorporated in Bulletin 199, now in course of publication. The work for the Navy was finished in the late fall of 1920.



Adding 30 feet to the length of a church, by rolling the church facade forward to its new site

Moving the 1000-Ton Front Facade of a Church

IN olden days, when the medieval cathedral builders wished to lengthen one of their great churches (and this happened very frequently), there was nothing for it but to pull down the western wall with its two towers, if it possessed any, or the eastern face, and lengthen the structure to the desired extent.

Today, however, thanks to the highly developed art of "House Moving," we can lengthen a church without any preliminary destruction of its principal front. As witness of this, attention is drawn to this striking photograph, for which we are indebted to Mr. Gustavus T. Britt of Buffalo, which shows the front of the Central Presbyterian Church, Buffalo, which he moved 30 feet eastward, to permit a lengthening of the auditorium to that extent. The front of the building is 78 feet wide over the lateral buttresses, 65 feet high, and 8 feet wide at the thickest parts. The weight of the wall as moved is 1000 tons.

The preliminary operations consisted of removing the front steps, preparing the new foundations, 30 feet to the eastward, and making a clean cut through the roof and through the side walls where they abutted against the church front. While this was being done the front wall was jacked up upon rollers. The work of moving the 1000-ton mass was done by means of screw-jacks, operated by 15 men, and the wall completed its journey of 30 feet without injury in 16 hours.

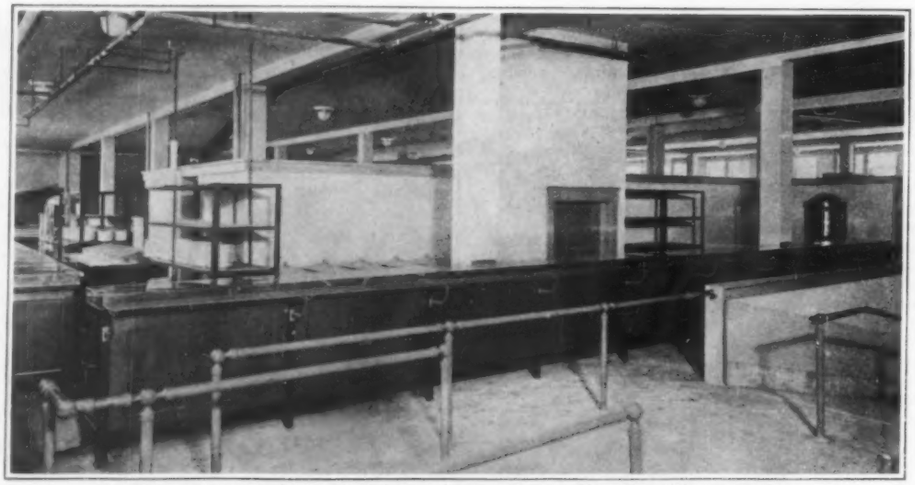
Stoking the Employee

Why Scientific Feeding in Company Restaurants Is a Benefit to Both Parties Concerned

By Charles Frederick Carter

MECHANICAL stokers for steam power plants having proved such an unqualified success, it was inevitable that some genius should adapt the idea to human beings. The distinction of being the first to install a mechanical stoker for feeding employees belongs to the Westinghouse Electric and Manufacturing Company, which has tried out the plan at its great works at East Pittsburgh, Pa., and found it good.

Now do not jump at conclusions: violent hands are not laid on workmen while prepared food is forced from a tube down their gullets as geese are fattened for market. While the essential feature of the mechanical feeder for workmen is a moving belt on precisely the same principle as the conveyor which moves coal into the furnace, the coal can not help itself, but must go along the conveyor, whereas the worker can, and does, retain liberty of action within certain limits. Such mechanical control as is brought to bear upon him is psychological rather than physical.



Serving-counters at the lunch club in a large factory. Note the aisle arrangement

This truly modern innovation was suggested by the perplexity of the average human being when suddenly confronted with the momentous decision between pudding, pie or prunes for dessert. No sympathetic person can witness without emotion the anguished indecision on view at the service counter of any busy cafeteria. Proprietors of cafeterias catering to the general public may fume inwardly when hungry lines are held up while some vacillating soul weighs the rival attractions of cream puffs and chocolate eclairs, but they are obliged to dissemble their feelings lest they drive away trade.

But the case of a great manufacturing company charged with the responsibility of seeing that several thousand workmen obtain their midday meal and get back to their benches within the 45 minutes allowed for lunch is altogether different. Delays in such a case are not to be thought of. So when the Westinghouse Company built its enormous cafeteria at East Pittsburgh moving belts were placed in front of the service counters, on which patrons rested their trays instead of sliding them along a rail in the usual leisurely way while selecting their lunches. The theory, amply confirmed by experience, was that while it would be possible to hold the tray stationary and let the belt slide along beneath, in ninety-nine cases out of a hundred the patron would respond to a subconscious urge to keep step with the mechanical pacemaker.

So strong is this urge that the motorman who stands at the controller can accelerate the belt 25 per cent and rush the line through at corresponding speed in case of necessity. It has been found by test that an average of 34 persons a minute can be served with the aid of the moving belt, which is from 33 to 50 per cent faster than the average speed in other cafeterias. To be sure, it sometimes happens that a workman, fed past the steam tables on the gallop, may snatch a plate of beans when his heart had been set on stew, thereby darkening his outlook on life for the rest of the day, and perhaps affecting unfavorably the quantity or quality of his work. But it is better for the company that an occasional disappointment of this character should be suffered than that scores should go without any lunch at all. The balance is decidedly in favor of the belt.

Nothing in the foregoing is to be construed as intimating that this corporation or any other treats the matter of providing lunches for employees in a spirit of levity. On the contrary, the lunch problem is a serious and important one. Rather tardily the discovery has been made that while man can not live by bread alone, neither can he live without it. It is now pretty generally understood that a warm, appetizing, wholesome meal at midday has a direct bearing on health, efficiency and dividends, while employees who eat cold, unsatisfying and poorly balanced rations at a dirty workbench are decidedly not as profitable as they might be made. However willing the worker may be, he simply can not put energy, intelligence and interest in his task without proper food any more than a boiler can generate steam without fuel.

The result is that much study and a good many millions of dollars are devoted to providing lunches, and often other meals also, for employees. While some of the more progressive employers established lunch-rooms years ago, the exigencies created by war conditions compelled a sudden and very great increase in the custom. Once established, the employees' lunch-room has demonstrated its usefulness so emphatically that it has never been abandoned, but, rather, improved and developed.

A moving belt at the serving counter—a means of speeding up the service

A survey conducted by the Department of Labor, while far from complete, indicated that more than half the industrial establishments in the country employing any considerable number of workers maintain lunch-rooms. In the great majority of cases the employers assume the first cost of the lunch-room or building and its equipment, as well as maintenance, and charge a price for meals intended only to cover actual cost of food and service, but usually resulting in a deficit.

The employees' lunch-room is too new to have become standardized, or even to have developed any outstanding practices. There seems to be almost as many different opinions about the most practical way of serving meals to a large force in a limited time as there are corporations serving them. For example, the Department of Labor, in a survey embracing 223 establishments which served lunches for employees, found 20 cases in which the management was turned over to outsiders and 13 in which employees had assumed the responsibility of catering for themselves in quarters provided and equipped by the management. The great majority of employers prefer to keep so important a matter under their own control.

Often the lunch-room is the product of a gradual evolution beginning with coffee and milk served free by the management to wash down the cold contents of the dinner pail. The next stage is likely to be the addition of free soup to the free beverages.

From such a beginning it seems to be an easy step to furnish a spare room, or at least a corner of the work-room with tables and chairs where the workmen may eat with more comfort. Not long after this stage has been reached the management may be expected to decide that it is worth while to erect a building fully equipped as a restaurant to serve lunches and other meals if necessary. At least it has worked out that way in a good many instances.

The desirability of lunch-rooms for employees being so widely recognized and methods of administration being so chaotic, perhaps the practices of some great corporations may be of interest.

The U. S. Steel Corporation, for example, operates 73 lunch-rooms in some of its plants. Results have been so satisfactory that a committee was appointed some time ago as a preliminary to extending the lunch service to study the subject of buildings and equipment and make recommendations for standard practice. This committee has recently completed its work, and a second committee to make a similar study of operation has been appointed. Small lunch-rooms and enough of them distributed around the plant so as to be within convenient reach of all have been found more desirable than a single large building serving thousands.

One feature of steel mill work which had a bearing on the decision in favor of small lunch-rooms is that men around furnaces and hot metals work in spells of 20 to 30 minutes. When they are off duty for a spell they like to visit the lunch-room for soft drinks, which, owing to the presence of some aromatic substance,

(*Continued on page 362*)

Our Subconscious Selves

Have We, Right at Hand, an Explanation for a Large Class of Psychic Phenomena?

By J. Malcolm Bird

THE phenomena to which the term "psychic" has been loosely applied are of two sorts, with a fairly distinct line of demarcation. On the one hand we have occurrences whose whole sphere of action lies in the human consciousness; which are devoid of demonstrable effect upon the external world or of visible connection with that world. On the other side we have the production of definitely "physical" effects by "supernormal" agencies.

The present discussion aims to catalog the more significant of the phenomena which fall in the non-physical category, and to supplement this with a few general remarks. Some of the items will be at once recognized as "psychic," others will not be so clearly of this character. For while we can with some success draw a line between the psychic phenomena which involve the minds alone of those concerned and the ones which bring in an actual physical effect, the psychologist well knows that in his field the normal shades imperceptibly into the supernormal, and the latter appears merely to be the former, extended or accentuated. We shall therefore not attempt this separation, but shall permit the normal to overflow into our discussion when it will.

The supernormal phenomenon whose existence will be least disputed by the hard-headed person who poohpoohs the whole subject is hypnotism. Indeed, it is not to be asserted with certainty that this is supernormal. We are all more or less susceptible to suggestion. To any suggestion that comes to us we ordinarily apply the critical faculty. We inquire whether it is in line with our wishes, whether there is logical reason for or against it; so far as we are able we examine it on its merits. Perhaps the only difference between the hypnotized and the unhypnotized person is that the ability of the former to do this is suspended. His ordinary cerebral associations inhibited, the hypnotic subject naturally and automatically responds to any suggestion put to him. It is not necessary that this be in the form of a command. Since he has no power to reject it, it may come in any form at all; but the impressive character of the performance is heightened by giving it as a command. The medical man who uses hypnosis, however, does not command his patient to ignore his ailment or abandon his vicious habit; he merely tells him that he has not got it, and the suggestion is accepted.

At the point where the operator acquires the necessary dominance over his subject this argument has been left blank; it tells what the hypnotist does but not how he does it. Here, if at all, the process is supernormal. But we all know persons whose suggestions carry great weight with us, and are ordinarily accepted. The hypnotist has perhaps found a wholly normal way to make himself appear irresistibly in this light to his subject. The less commonplace alternative will appear later.

Closely parallel to hypnosis are numerous phenomena where the subject may be regarded as having hypnotized himself. The practice of crystal-gazing has been universal. Stripped of all hocus-pocus, it comes to this: A respectable percentage of humans find, on concentrating the gaze upon certain objects and striving to make the mind a blank, that pictures appear in the visual field. The object of the gaze may be a ball or crystal of glass, quartz, etc.; a bowl of water or anything else giving the impression of clearness and depth; a pool of ink, a slab of polished stone, a mirror, a finger-nail, etc.; even the empty hand sometimes suffices. A person either can induce these pictures, in which event he may discover the ability by accident; or else he cannot, in which case he may stare his eyes out and nothing will happen. This makes it easy for those who cannot see the pictures to discredit the whole business; but there can be no rational disbelief that the power exists as outlined. The pictures seen are of a wide variety, but the general style of art favored by a given crystal-gazing eye is fairly uniform. The visions may be stills, or action pictures.

A close analogy are the phantasies which many of us have when half awake. Probably more of us are subject to this than to crystal-gazing. With closed eyes, between sleep and waking, we see faces, landscapes, all manner of things. I am able to distinguish between visitations of this sort and true dreams by my ability to command the waking vision. I cannot induce or dismiss it at will, but once given the picture I can control its behavior and am usually conscious of so doing. This is the only psychic experience to which I am subject.

Of rarer occurrence, but undoubtedly genuine so far as its subjective character to the percipient is concerned, is the true hallucination of wide-awake consciousness. Occasionally auditory, this is usually visual. The apparition, ordinarily of a dear friend or relative, presents itself, lasts for an indeterminate period, and vanishes. It may be of a person known to be living or known to be dead; in either event it may present the appearance of life or of death. It may speak or be silent; it may remain motionless, move at random, or act a part. It is seldom, if ever, recognized as hallucination until it has passed—not always then.

The subjective mechanism of all this is simple enough. We have certain sense organs, with their lines of communication and their associated brain-areas which receive and interpret their messages. It is difficult to get away from the supposition that these circuits are electrical in nature. Ordinarily they are closed to the action of any other stimulus than the sort they are designed to receive. But it is far more difficult to imagine that this insulation is absolute, than to suppose that at times the circuit is subject to extraneous influence of some sort. And just as extraneous currents in a telephone circuit set up sound waves at the receiving diaphragm, it seems fairly inevitable that external currents in, say, the visual circuit must set up visual impressions at *their* receiving terminus. The character and intensity of the extraneous factor would presumably determine whether associative as well as perceptive centers would come into action, and accordingly whether the picture seen would be a more or less familiar one. The nature of the extraneous force acting would, of course, determine whether the phenomenon would have to be regarded as normal or as supernormal; of this we are not quite ready to speak.

Touching hypnotism from another angle is multiple personality. This condition is never induced, never in any way at the sufferer's command. It is suggestive of the introduction from without of the extra personality, and the possession of the victim's physical and mental structure thereby. The fact that in authenticated cases there has ensued a struggle between the two identities for ultimate possession has been cited in behalf of this viewpoint. But in recent cases treatment of dual personality has taken the direction of a successful effort to aid the merging of the two streams of consciousness; and this makes the phenomenon look more like a strictly subjective one.

The theory that an external intelligence may be operating upon the corporeal rind of the subject links multiple personality with automatic writing. Here again we have a phenomenon lending itself readily to deception, and nothing is to be gained by ignoring this. But nothing is to be gained, either, by holding out against the obvious fact that in a majority of cases automatic writing is without the operator's volition. It may occur when he is in a trance—spontaneous or induced, pathological or healthy; or when he is apparently normally awake. His attention may be on the writing, on something else, on nothing at all. He may be conscious of the message as it develops; of words as they are formed individually but not of the context; or of nothing at all in connection with the message.

Things completely forgotten may be recalled through automatic writing. Rarer but far from unique are cases where knowledge is presented by the automatic writer which it seems certain he could never have had. Persons of mediocre attainments display literary ability, or exhibit mastery of subjects with which they have plainly never been in contact. The penmanship is ordinarily that of the agent, but often a distinctive hand is adopted for these communications. Occasionally the same automatist will employ several of these, keeping them apart without confusion. Sometimes the hand of living or dead persons will be imitated.

With appropriate modifications to meet the different operating details, practically everything said of automatic writing applies to oral mediumistic communications. We do not have to accept these as from the dead, but we must accept the fact that many of them are without fraud and without volition on the part of the agent.

With all these phenomena the same question arises. The picture seen in the crystal, in the waking dream, or as an outright vision; the extra personality that appears and vanishes; the message of pencil, planchette, or voice; are these mere phantasies without significance or do they represent a real message of some sort? The attempt to answer presents numerous difficulties; passing these for the moment, it leads us at once to one further important psychic manifestation of the mind alone—telepathy.

We all know what this term covers. We must all realize that its very name implies a simple, straightforward explanation of the puzzling occurrences listed above. But—does telepathy exist, itself? Its occurrence is admitted by its supporters to be usually spontaneous; failure of attempts to operate consciously and with intent is not necessarily conclusive against it. The direct experimental evidence in its favor consists in part of trials in which direct transference of thoughts, images or sensations was attempted; in part of successful hypnotism at a distance, which fairly defies explanation on any other ground; and in some part of the very fact that thus is simply explained much that without telepathy must for the present go unexplained. Aside from fraud, in any independent test of telepathy precaution must be taken against accidental reception of the desired information—thus, if one think of a number hard enough, the lips are apt to form it unconsciously, and the recipient may with equal absence of knowledge or intent read this message. It is also necessary to guard against the operation of chance. If I draw a card and you try to name it, you should score one success in 52 attempts; in 2700 tries, two of the 52 successes that are coming to you for this period ought to occur consecutively. You will have to do much better than this, over a considerable period, before I shall admit anything beyond a run of luck.

When we check up the possibility of telepathy by investigating the reliability of the reports rendered by other psychic phenomena which might be due to it,

INCREDULITY may go to lengths as absurd as credulity. The man who believes nothing at all is as impossible as the man who believes everything. One who will not credit the occurrence of the phenomena which for want of a better title we group under the term "psychic" has made a vice of skepticism, and in its name rejects what is true but unwelcome. If we but remember that we can accept the occurrence of these things without committing ourselves to any particular explanation of them, the admission that they really do occur loses its sting.

If he were asked whether he believes the explanation which, borrowing from others, he has outlined in this article, the author would answer frankly that he does not know. It may be objected that he has treated the subject more sympathetically than this state of mind would warrant. We do not see that he has suppressed anything unfavorable to the hypothesis with which he deals; and after this, it seems to us that if this hypothesis is to be exhibited at all, it should be presented with some sympathy. Aside from any question of actual acceptance, the author is the more inclined to give this sympathy because, to his mind, the hypothesis of his text is vastly to be preferred to any explanation involving the direct action of departed personalities. Unless and until it is shown that it contradicts itself or contradicts something else that we can less afford to give up, it covers the ground so completely that work in other directions is really without point. As stated in the text, it is for this reason alone that it is put before the readers of the SCIENTIFIC AMERICAN *as part of our series on the psychic.*—THE EDITOR.

we meet another difficulty. One who is at all subject to apparitions is likely to have them more than once. It takes real strength of mind to remember the vague ones and the ones that did not come true, to give these a place of equal importance in memory with the ones that actually marked the death of a husband or a father. Moreover, any one has quite vividly in mind, from time to time, the *thought* of a loved one. If some day such a thought turn out to have coincided with a crisis in the loved one's life, this occasion is all too likely to get remembered as a true apparition, while its hundreds of meaningless but at the time equally vivid predecessors are completely forgotten. So an actual census showing what purports to be the ratio between meaningless apparitions and those that turned out to have significance will be misleading unless corrected to take up this error in reporting.

Without giving space to actual experiments, precautions, corrections, etc., it may be stated that all the investigations suggested by the preceding have been made, and that as a result there appears to be fairly conclusive evidence that a means of communication between two minds exists, outside of those that involve the ordinarily recognized senses. Some persons seem to possess the power of transmitting or receiving at will; with the large majority, either aspect of telepathy is spontaneous, when indeed it occurs at all. Definite suggestions as to the physical mechanism of telepathic communication are of less significance here than certain of its existence or non-existence.

The present evidence is altogether in favor of its existence. Granting this existence, the bearing upon all we have said is so plain that I need go into no details to make it clear that we have available an explanation for all the phenomena mentioned above. It has been objected that if we attribute all these phenomena, without reserve, to telepathy, it seems necessary to grant that the telepathic faculty can search the minds of all the world and help itself to what it wants; for numerous messages are recorded which gave facts, subsequently verified, that nobody present could possibly be conceived ever to have had, or which no one person in the world could ever have had in their entirety. But has not the difficulty been magnified?

F. W. H. Myers was the first to formulate, partly from normal and partly from supernormal phenomena, the idea of the subconscious mind, the subliminal self. In his hands the concept took later an unfortunate turn toward actual spiritualism. From this fate it has been rescued by other psychologists, and restored to at least controversial standing. Numerous differences of opinion naturally surround such a subject. Without regard to these, without intent to support the theory definitely in any way, we may set down its general features.

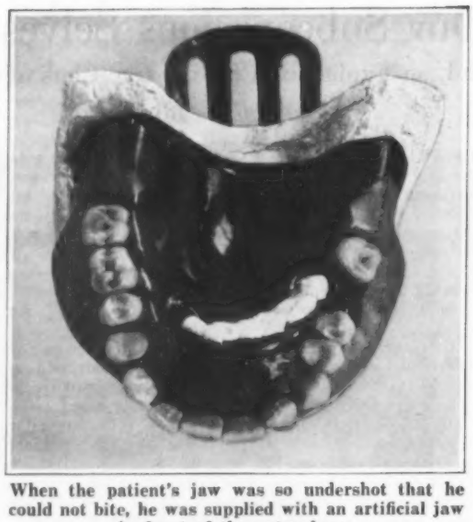
Our minds are dual. Everything that takes place above the level of consciousness can equally take place below. The subconscious element of the mind is in every respect as capable as the conscious—it takes charge, when necessary, of all the mind's functions. In many ways this duality is as pronounced as though we possessed two distinct personalities.

The subconscious is always "aware," if we may use the term, of everything that goes on in the conscious mind, of every impression that comes to the latter. In addition, it takes in much that goes clean past the conscious mind without making any impression whatever.

The subconscious is always in complete contact with the conscious. Only at times and under exceptional conditions is the current reversed, so that the conscious can tap the subconscious. When these exceptional conditions are met, things that have been below the threshold rise above it, and we become conscious of them—perhaps for a second time after a period of complete forgetting (distinguished from the mere dismissal from mind of the things we can recall at pleasure), perhaps actually for the first time.

Extreme advocates are apt to claim that the subconscious *never* forgets. I do not find this as objectionable as it might at first glance appear; but it is not really necessary. It can be displaced by the wholly innocent hypothesis that the subconscious forgets with comparative rarity; in some respects, this might meet the observed facts of psychic phenomena—particularly their uncertainty—better than the alternative of infallible subconscious memory.

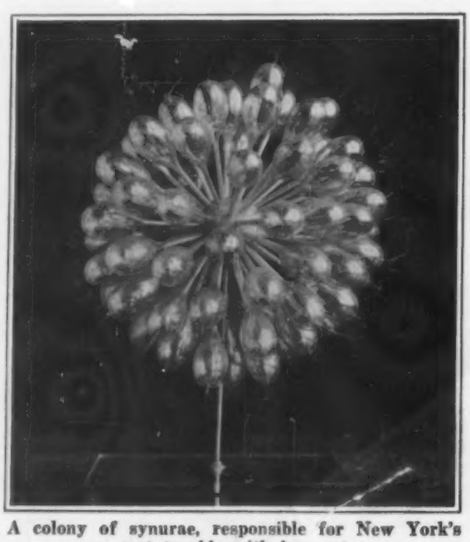
The subconscious mind would be the seat of the telepathic function, as regards both sending and receiving. Ordinarily, of course, we should be quite unaware of the process. Our subconscious minds may be ever accumulating a store of impressions received from other minds—received in some way that we understand as little as Archimedes would have understood a wireless concert, but of which we may hope we are on the path toward an understanding. And then, when conscious comes into contact with subconscious—under conditions which in our present crude state of knowledge we need not even attempt to define—anything which is in the subconscious, anything which it has ever received and retained, may come forward into consciousness. Perhaps the choice of what shall thus come forward is made in some orderly way by the subconscious; perhaps it is largely a matter of chance—just as, when in a reminiscent vein, anything whatever comprised in our store of ordinary memories may, at random, come to the top.



When the patient's jaw was so undershot that he could not bite, he was supplied with an artificial jaw in front of the natural one

If we may grant all these assumptions, we have a perfectly normal and scientific explanation for any psychic phenomenon which my imagination is capable of picturing. For nothing that I ever knew is really lost if I can but establish contact with my subconscious half at the moment when I want to know it. And nothing which anybody else may ever have known can be proved to have been lost. Anything which was ever in any mind may have been passed on to another, and another, and another; and there is absolutely nothing to prevent it from turning up in your subconscious mind, or mine—and some day, when conditions are right, from rising above the threshold!

The present problem of psychic research, as I see it, is to investigate every link of this chain with the utmost care. If it can be overthrown at any point, let us find this point, overthrow it, and start all over. If it can't be overthrown, we need carry psychic research no further; everything that can happen is accounted for. Simple telepathy for most things, coupled with the necessary contact between the recipient's conscious and subconscious minds. For the more mysterious items, telepathy carried through a series of subconscious minds—as many of them as you please the property of persons who have died since delivering this message. If a message were to be received today from Julius Caesar, giving information which we could be sure none but Caesar ever had and which we could verify with certitude, it could be explained without a hitch if this hypothesis be admissible. Caesar subconsciously passed it to A, and A to B, and B to C, and so on to the present generation, when for the first time it rose above the level of consciousness of one of its recipients!



A colony of synurae, responsible for New York's recent trouble with her water

Foolish? Maybe so; but it is at least self-consistent. If you prefer to believe in ghosts, that is all right, too; but you must make as plausible a showing for the ghosts as this theory makes for itself. Improbable? No more so, as I see it, than lots of the amply verified phenomena which we are today called upon to explain—and which we can explain by its aid. In any event, it is not to be disposed of by calling it names, or by expressing repugnance for it, or on mere metaphysical grounds. It explains a lot of things that need explanation, and until it is conclusively shown, on scientific grounds, to be impossible, a lot of people are going to go right on believing in it. It does, indeed, as a writer in the "Britannica" remarks, put a hopeless burden of proof upon any alleged ghost. Incidentally, if you did not know that the "Britannica" took this subject seriously, refer to page 940 of the index volume; and read some of the articles there listed under the head "Psychic Research." Finally, do not forget that we have a body of attested phenomena which make it clear that somewhere there is something that we do not know about; why, asks the advocate of the theory I have outlined, may this not just as well be in that indefinite thing we call the mind, as anywhere else?

A Novel Trick in Dentistry

CONFRONTED by a patient with such an overshot jaw that it was impossible for him to make contact between his upper and his lower jaw, Dr. A. Pimienta, a New York dentist, designed a dentition which gives the subject in question a normal "bite," without demanding the extraction of his natural teeth. The photograph at the head of our second column shows how this result was achieved. A sort of artificial jawbone was built up beyond the limits of the natural one, and an ordinary set of false teeth mounted on this. The natural teeth, instead of being removed, were left in place behind the artificial ones, with a light rubber dam about them to keep them out of mischief. The jaw thus treated was the upper one; the under jaw required no modification at all. So new is this artifice that Dr. Pimienta has been able to get protection on it, and his patient is in the unique position of having a patented mouth.

Cucumber-Flavored Water

ALL city water has at all times a large micro-organic content. It is the function of the water-supply authorities, of course, to keep the supply under continual service in the interest of excluding actual disease-bearing germs. But there are vast multitudes of bacteria that are not pathogenic. The bulk of these are quite neutral to the human system, so that their presence or absence is a matter of indifference. Some of them are actually beneficent. The remainder are not actually harmful in the same sense as are disease germs, but on some other ground are objectionable. Thus, certain species, when present in unbelievably small numbers, impart a noticeable flavor to the water.

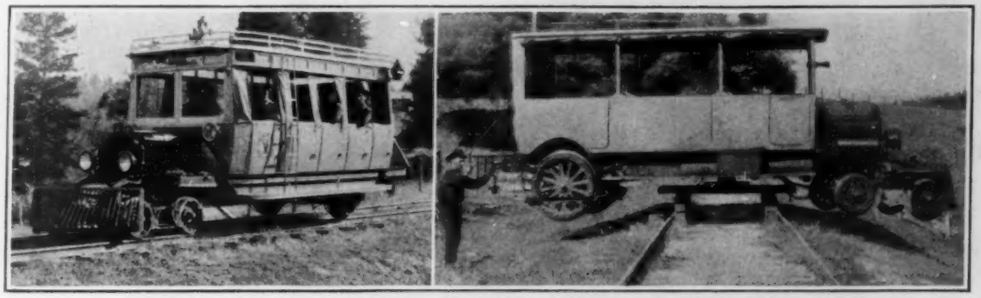
New York has recently had quite a siege of this sort of thing. For a long time there had been a curious, mildly objectionable flavor to the Croton water—described by some as merely "dry," by others as "tasting of the pipes," and by those of more delicate palate as resembling cucumber. During the early winter it got so much worse that many restaurants and homes were obliged to buy spring-water for drinking purposes; and the cucumber quality became unmistakable.

We illustrate the micro-organism synura, which is responsible for all this. It is in every way harmless, but it discharges into the water an oily substance which is directly responsible for the objectionable taste. The only way to prevent this is to prevent synura itself. The organism is an extraordinarily rapid reproducer, but the introduction of copper sulfate into the water kills it fast enough to catch up, ultimately, with its powers in this direction. The process is a slow one, however, and in the case of New York it was several months between the initial attack and the final subjection of the little nuisance.

As our photograph indicates, the synurae live in groups, attached to one another, so that the entire colony looks somewhat like a head of sunflower seeds. The fine, hair-like whips are for the purpose of locomotion; the entire colony moves as a unit when these lash the water. Further details of these interesting and annoying creatures may be found in the SCIENTIFIC AMERICAN for June 14th, 1919.

Cars That Carry Their Own Turntable

A NUMBER of automobiles equipped with flanged wheels for operation over the rails of the Hetch Hetchy Railroad are equipped with turntables by means of which the automobiles can be turned end for end. The turntable consists of a fifth wheel, mounted under the center of the car, to which two pieces of heavy angle irons are attached. Jacks are placed under these angle irons and supported on blocks. The driver then raises the automobile until the wheels will clear the rails. He then places blocks under the angle irons and removes the jacks. The driver then swings the automobile about until it faces in the opposite direction. After the car is turned around, jacks are placed under the angle irons and the car is lowered to the track, when it is ready to proceed. Chains are used to prevent too great expansion of the springs of the pony trucks when the weight is removed from the wheels.



Gasoline railroad-cars that carry a turnable and make a switchback unnecessary

In order to operate the automobiles with absolute safety to the public, three separate and distinct sets of brakes are provided—the service brake, operated by a pedal contracting on each rear wheel; the emergency brakes, operated by hand lever and expanding on drums on the rear wheels, and four brake shoes, operating one on each wheel of the pony truck.

One of these trucks is equipped as a mail and express car and one is fitted up as an ambulance with a removable stretcher. This stretcher is carried under the roof of the automobile. One of the cars is especially equipped to haul passengers and tourists. A railing runs around the top where baggage is carried. A steel ladder gives easy access to the roof.

This summer for the first time tourists are being carried over the Hetch Hetchy Railroad in these automobiles. The scenery along this route compares favorably with the Canadian Pacific and Royal Gorge Railroads, and has aroused the greatest enthusiasm from all who have taken the trip.—By *C. W. Geiger.*

The Cementing Qualities of the Calcium Aluminates

THE four calcium aluminates, $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, $CaO.Al_2O_3$, and $3CaO.5Al_2O_3$, which are the only anhydrous compounds of lime and alumina, were prepared in a pure condition by heating together the proper proportions of these compounds. After microscopic examination had shown that homogenous compounds had been formed, the products were finely ground and their cementing qualities when gaged with water were determined.

The two compounds higher in lime reacted very energetically with the evolution of much heat, acquiring practically instantaneous set. The two compounds higher in alumina reacted with water more like Portland cement, but showed higher strength at early periods than the latter. It was thought desirable therefore to prepare these in larger quantities and containing such impurities as silica, iron oxide, and magnesia, which would generally be present in lime and alumina of natural origin. The two compounds $CaO.Al_2O_3$ and $3CaO.5Al_2O_3$ were consequently burned in a 2 by 20 foot rotary kiln, varying their composition so that the silica, iron oxide, and magnesia reached limits of 17.38, 3.10, and 3.66 per cent, respectively, as maxima in a series of eight cements. The process of manufacture was entirely similar to that used in the production of Portland cement.

The ground cements were used in making the usual small tension and compressive test pieces and 6 by 12-inch concrete cylinders used of 1:1.5:4.5 and 1:3:9 proportions. The striking feature of the data obtained from testing these at different periods up to and including 3 years was the very high 24-hour strength. The rich concretes prepared from four of the cements developed in 24 hours strengths in excess of 2800 lb. per sq. in., and the lean concretes from two of the cements gave strengths beyond 1500 lb. at the same period. Consistent gain in strength was obtained up to 1 year, when one of the cements in the rich concrete gave a strength of no less than 8220 pounds per square inch.

Test pieces stored in water tended to show retrogression in strength with age. This was also noted with test pieces stored in the damp closet, but to a much less degree. This action may be explained by the fact that the products of the hydration of all the aluminates are a hydrated $3CaO.Al_2O_3$ and hydrated alumina (except in the case of the anhydrous $3CaO.Al_2O_3$, when no hydrated alumina is produced). This latter is the cementing agent in these products, and, being colloidal, it is very susceptible to moisture changes. Large amounts of moisture are taken up in the presence of the latter with consequent swelling of the colloid and reduction in strength.

Still Oil Engine for Marine Propulsion

THE Still oil engine constructed by the Scotts Shipbuilding and Engineering Co., Greenock, for use on shipboard, and tested by a deputation of engineers representing the French Government and commercial interests, is said to be the largest of the type so far constructed and is of the slow-running marine type designed for merchant service. The Still engine is a combination of oil and steam engines. The main source of power is oil, consumed within a cylinder on the down stroke. The steam is generated in the cylinder jacket and forms a supplementary source of power used on the up stroke.

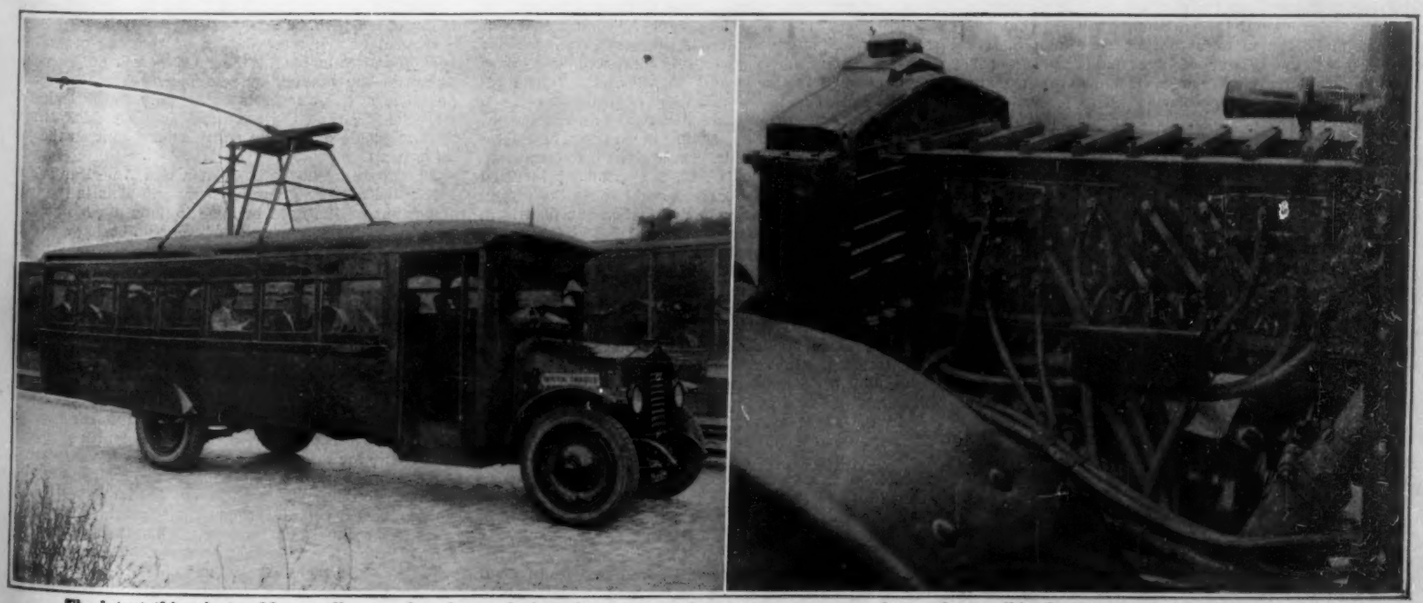
The present engine has the following main dimensions: Stroke, 36 inches; bore, 22 inches.

In trials in May, 1921, the following efficiencies were obtained: At full load the combustion indicated-horsepower efficiency was 44.8 per cent, engine brake-horsepower efficiency 39.4 per cent, and net brake-horsepower efficiency 37.7 per cent; the respective efficiencies at half load were 46.2, 38.5 and 35.8; and at quarter load, 46.1, 34 and 30.0. The total oil consumption per indicated-horsepower-hour was found to be lower than in a good Diesel engine; or at full load 0.360 pound per brake-horsepower-hour, 0.398 pound per brake-horsepower-hour at an overload of 11 per cent, and as high as 0.47 pound at quarter load.—*Engineering (London).*

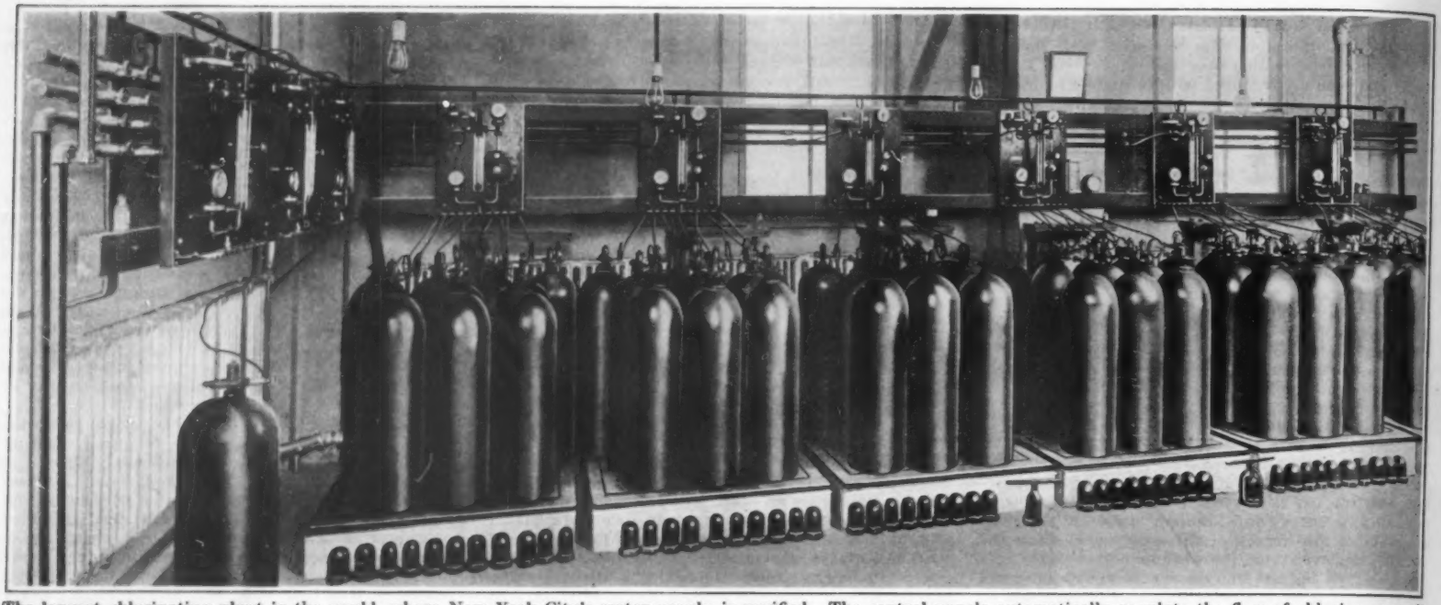
Electric Trackless Trolleys That Look Like Automobiles

A GASOLINE bus adapted to electric drive and used as a trackless trolley is the latest development in electric traction progress. The driving motors and control apparatus are placed beneath the hood of the car, which is retained, and to all outward appearances looks like the front end of a regulation gasoline car. In fact, the bus is interchangeable between electric or gasoline drive, as desired. One of these busses was recently given trials at the General Electric plant in Schenectady and has been sent to Detroit for demonstration on the Municipal Railway lines in that city.

Two standard 600-volt railway motors connected in tandem furnish the motive power and are supplied with current from two overhead wires by means of a sliding-type collector mounted on a special trolley-base raised above the roof of the car. The bus speed is about 23 miles per hour, maximum. The bus weighs 11,740 pounds, is 25 feet long, 88 inches wide, and seats 29 passengers and a driver. The trolley-pole is mounted on a semi-universal joint, so that it restricts the maneuverability of the bus little if at all.



The latest thing in trackless trolleys, and an internal view showing how the motors are arranged to make possible the automobile-type front elevation



The largest chlorinating plant in the world, where New York City's water supply is purified. The control panels automatically regulate the flow of chlorine per unit of water flow, keeping the former constant regardless of tank pressure or temperature

Peace-Time Jobs for Poison Gas

How Chlorine and the Other Members of the Family Have Been Put to Honest Work

By Harry A. Mount

TO those who have followed, even in a casual way, the development of armaments during and after the war, it is apparent that any future conflicts will be won as much with poison gas as with bullets and bayonets, or with airplanes and battleships. And yet these same poison gases which are so effective in war have a peace-time value even more significant.

It would be a mistake to attribute all of our late progress in chemical industries to the stimulus of war, but it is true that there is hardly a department of industrial chemistry which has not been directly affected. It is true, also, that some of the most deadly of poison gases, developed for the single purpose of war, are now serving the most peaceful of purposes. It will be the purpose of this article, not to outline our chemical development, but to show how new uses for these deadly gases are constantly being discovered and to point out some of the newer applications.

The pence-time work on poison gases in this country has been mainly along two lines. One is the development of coal-tar derivatives and the other is in finding jobs for chlorine and its compounds. It is hardly necessary to point out the enormous progress that has been made in the manufacture of coal-tar products, especially in the matter of dye making. But this progress has been largely of a technical nature and consists in working out problems which German chemists had solved years ago. The importance of this work can hardly be overemphasized, but it does not hold the spectacular interest of the other line of development—that of finding jobs for chlorine—for in this latter activity new and important fields have been explored.

Chlorine was the first poison gas used in battle by the Germans, and it was the basis of many of the most toxic gases developed later. The properties of chlorine were fairly well known before the war, and already it was used to a limited extent for bleaching, for purifying water supplies, etc.

Chlorine has come into almost universal use for purifying the water supply of cities. At the present time some 2025 American communities use chlorinated water, consuming 4,000,000,000 gallons of water daily, and serving a population of 40,000,000. One important result is seen in a reduction of 70 per cent in the death rate from typhoid in cities from 1913 to 1919. (The last date for which figures are available.) During this same period the typhoid rate in rural districts decreased only 10 per cent.

Originally these applications of chlorine were made in the form of chloride of lime, of which the active agent is chlorine. Such installations, however, are now being rapidly replaced by apparatus for the use of liquid chlorine.

Chlorine gas is one of the derivatives of common salt, obtained by electrolytic action. A saturated solution of clean brine is piped to a group of cells, through which a current of electricity flows at low potential. The salt is decomposed into two elements, sodium and chlorine. The sodium is formed at the cathode and in reacting with water forms caustic soda. The chlorine gas is freed at the anode, from which point it is drawn off through a system of piping to a liquefying plant. It is dried, compressed and refrigerated and stored in steel cylinders, in which it is available to consumers. The liquid gas exerts an internal pressure of about 150 pounds to the square inch on the tank at room temperature, and it is evaporated into a pure gas immediately upon being released from the cylinder.

Aside from its most important use in purifying water, chlorine gas in this form finds wide application in bleaching processes, chlorine being the active agent in most commercial bleaching solutions. Great quantities of the gas are used in textile and paper mills, laundries, etc., for this purpose.

One of the more recent uses is in sterilizing city sewage to render it harmless before discharging into a stream or lake and in similar treatment of trade wastes. Many tanneries now use chlorine as a weapon against the anthrax germ, so deadly to humans. A field recently invaded is the sterilization of swimming pools. A small quantity of chlorine will render the waters of a pool absolutely sanitary, saving the expense of emptying the pool and refilling it. On a great pool completed recently in Washington, D. C., a small boat is fitted with a unique chlorinating plant and it plies the waters all day long, discharging chlorine, when the pool is in use. A similar experiment has been tried at Cleveland, where the waters of a public beach are chlorinated by a plant in a small boat. It is claimed that one application will remain effective at the beach for several days.

A Yale professor has recently made the discovery that bad odors can literally be gassed to death by the use of chlorine. His method is to release a measured quantity of chlorine gas into a stack carrying the odorous air. A combined chemical and electrolytical action takes place, and a few feet from the point of application the air in the stack is found to be free of odor. The importance of this discovery may be realized from the fact that through its application the height of a stack planned to carry away odors from a sewage disposal plant in Cleveland has been reduced from 200 feet to 50 feet. In many cases it will be possible to eliminate the odor from garbage, sewage and trade-waste disposal plants which now create a public nuisance.

Every well-equipped hospital now has a small plant, consisting of a chlorine cylinder and special control apparatus for the manufacture of the Dakin-Carrel solution. This solution was used in the military hospitals for the sterilization of wounds and has proved so effective that it is now standard in civil hospitals. Chlorine also is the base of several household sanitary solutions sold under widely advertised trade names.

A number of interesting experiments with new uses for chlorine are being carried forward. In one of these a large packing concern is investigating the possibility of using highly chlorinated water in packing fruits and vegetables. This eliminates part of the cooking and helps preserve the natural flavor. At least two other important discoveries in the application of chlorine of great commercial importance have recently been made, but their nature can not be revealed at this time.

It must not be imagined from the foregoing that uses for chlorine are being developed to the exclusion of the scores of other gases developed for war use. One of the most interesting of recent applications is the use of ethylene instead of acetylene for welding. It is said to be more satisfactory for this purpose and a welding outfit which can be carried on a man's back is practicable because the weight of a solvent for the acetylene is dispensed with.

Several of the most deadly of the war gases have been found valuable in the most gentle of pence-time pursuits—the making of perfumes. From the deadly phosgene a violet scent is extracted more delicate and more lasting than the woodland flower yields. Benzyl acetate yields a jasmine scent as fragrant as the jasmine itself.

Dinitrophenol is the basis of a new American sulfur-black dye of very great importance. This is the most important of the dyes because it finds a wide application in dyeing such articles of wear as hosiery. It was one of the dyes which German chemists were confident we could never produce, but recent reports say the American dye is better than the imported German black. Tremendous quantities of cellulose acetate, developed for use as an airplane wing dope, are now used in the manufacture of artificial silk.

Sulfur chloride, used with ethylene in the manufacture of mustard gas, finds wide peace-time application in the manufacture of rubber.

One of the important new uses for a number of poison gases is in the destruction of rodents and insect pests. Phosgene, for example, has been used very successfully in killing rats around wharves, breakwaters, etc. Cyanogenbromide is used in the holds of vessels and other places where the phosgene would corrode the metal, for the same purpose. This is important not only because rats destroy property, but in preventing the spread of such diseases as bubonic plague. Hydrocyanic gas is finding a tremendous use in protecting the citrus groves of California and the South from insect

pests. Efforts are under way to attack with poison gas the locusts which overrun parts of the Philippines, Kansas and other parts of the United States. There has been little success in attacking the cotton boll weevil of the South, but this problem has not been given up as hopeless.

Wide publicity has been given recently to tests of the efficiency of tear gas in the handling of mobs. Indications are that this harmless but exceedingly effective weapon will largely replace machine guns and clubs in such emergencies.

We have sketched here only a few of the more important uses to which poison gas is being put. There are literally thousands of new applications and everywhere in industry these are facilitating industrial processes, creating new products, bettering old ones, and reducing costs. Perhaps we shall yet have reason to be thankful for the day the Germans released over a stretch of Flanders trenches a cloud of greenish gas that broke the spirit of the bravest men and sent them reeling and coughing in retreat.

A Warning Concerning the Peace-Time Use of Army Gas Masks

WARNING that the Army gas mask, while capable of giving protection against the deadly gases met on the battlefield, does not protect against all the gases or atmospheres encountered in mines, in the industries and in fire-fighting, is given by the United States Bureau of Mines.

The dangers from gas that city firemen face and the need of standardized methods of protection against them have been pointed out. The need of a knowledge of such gases on the part of city firemen has been especially emphasized by overconfidence in the capacity of the Army type of gas mask to protect the wearer against industrial gases, an assurance that has probably arisen because soldiers were taught that the United States Army gas mask would protect them against all the gases they might encounter. This statement, true for the battlefield but not true for all industrial gases, including products of combustion, has been brought back by soldiers and spread generally among workers. Furthermore, city firemen and mine operators have been circularized with letters and advertisements of Army gas masks offered for sale by certain persons who made unreserved statements, probably through ignorance, that the masks would protect wearers in mines and burning buildings. The falsity of these statements was evident to the Bureau of Mines, which took steps immediately to notify the public that Army gas masks had serious limitations, especially when used in fire-fighting or in any place where unusually heavy amounts of poisonous gas are present. This warning has been verified by the actual experiences of some city firemen who have tried Army masks. On the other hand, the excellent qualities of the masks have also been demonstrated at fires.

Whether or not firemen should adopt the Army gas mask for general use has been much discussed. Theoretically it would seem that the half-hour oxygen-breathing apparatus, which keeps out all gases and supplies oxygen, would be much safer than the gas mask for fire-fighting. But practical experience shows that firemen, as a rule, do not favor oxygen-breathing apparatus. To them it seems cumbersome and uncertain in action. The combination of oxygen cylinder, breathing bag, regenerator canister, valve and pressure gage appears too complicated for the rough and ready work of fire-fighting. Although such apparatus has been on the market for a number of years, it is seldom put into practical use, even when on hand, at fires. Firemen prefer to take their chances unencumbered, or at most simply to tie a wet handkerchief or towel over the nose and mouth to keep out some of the smoke.

Therefore the utility of the gas mask must be considered from the practical point of view rather than the theoretical. A review of the many reports of tests in experimental fires by city fire departments shows: That firemen are favorably impressed with the simplicity of the gas mask and will wear it; that in the great majority of these tests it protected the eyes and throat from irritating smoke and was a great improvement on sponge respirators and wet cloths; that the mask did not encumber the wearer or retard his effectiveness in fire-fighting; that no special training was required in learning how to use the mask; that in comparison with the oxygen-breathing apparatus very little attention is required to keep the gas masks in good condition.

These experiments by fire departments corroborate the experiments of the Chemical Warfare Service and of the Bureau of Mines in proving conclusively that the Army gas mask, when fitted with a canister containing cotton filter pads, activated charcoal, and soda lime, effectively filters irritating smoke particles, and, in addition, protects against most chemical fumes in the concentrations likely to be met in fires.

However, in using the Army mask the following serious limitations must be kept in mind: It furnishes no oxygen; hence it should not be worn into a place where a safety lamp or a fireman's oil-burning lantern will not burn; it should not be used where there is reason to suspect carbon monoxide, as in smoldering fires in basements and other confined, unventilated spaces, and especially in confined places where broken illuminating gas pipes add carbon monoxide to the air; it offers very poor protection against ammonia; finally, the Army mask may break down in unusually high concentrations of poisonous gases. It was originally designed for outdoor use, where the poisonous gases are considerably diluted with air. Caution must be used, therefore, in going into rooms where the concentration of the accumulated gas may be great enough to pass through the mask.

Perhaps the most serious limitation of the Army mask for fire-fighting is its inability to protect against ammonia and carbon monoxide. Although special ammonia canisters are now available, commercially, and carbon monoxide canisters soon will be available, the fire-fighter does not know in advance what gas or combination of gases he may find. Many buildings contain ammonia refrigerating plants, and all cities outside the natural gas belt are piped for artificial gas containing carbon monoxide. The fireman, therefore, must have, in a single mask, protection against all these gases. Enough progress has been made by chemists working under the direction of the Bureau of Mines, and subsequently in the Chemical Warfare Service, in the development of an absorbent for carbon monoxide to raise the hope that a combination canister for a fireman's mask which will protect against smoke, ammonia, carbon monoxide, and practically all chemical fumes, will soon be commercially available. When this is accomplished a fireman can be protected in any atmosphere where a safety lamp will burn.

In order to promote the production of an adequate combination gas mask for fire-fighters, the Bureau of Mines will cooperate with city fire departments in obtaining more accurate information as to the actual gases present in connection with fires, and with manufacturers of gas masks in testing and approving suitable gas masks when submitted to the bureau. Fire departments desiring to cooperate in obtaining information on the presence of carbon monoxide in gases from fires should communicate with the Pittsburgh, Pa., experiment station of the Bureau of Mines.

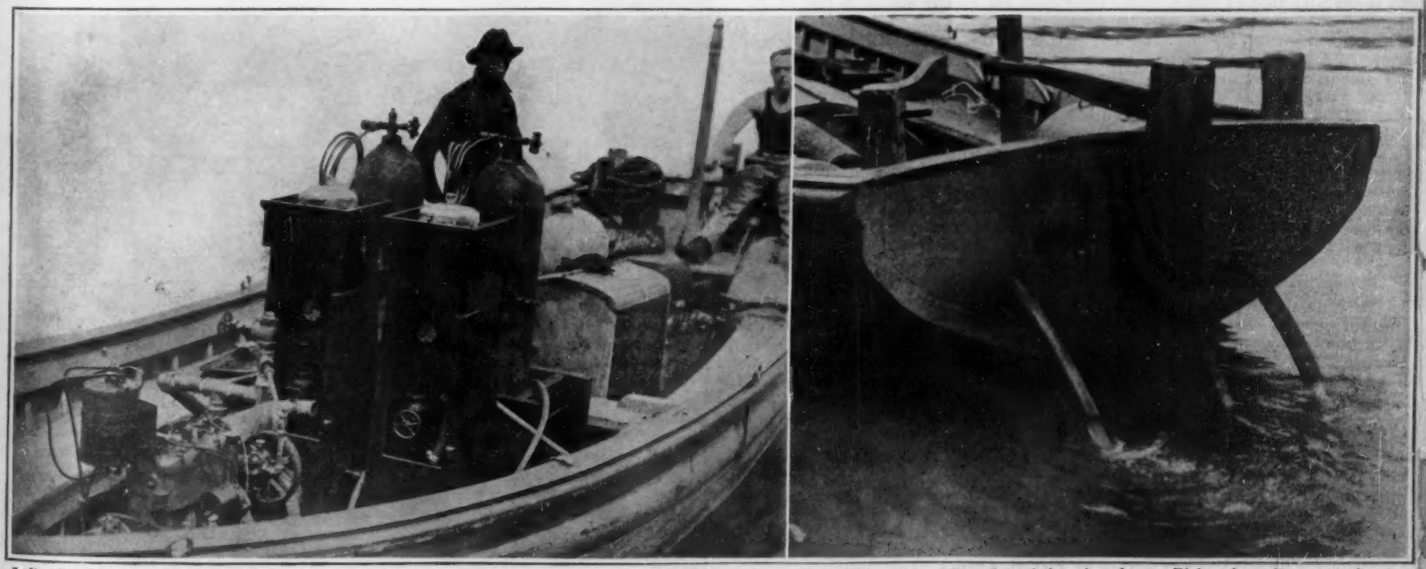
The ordinary Army gas mask can not protect the wearer from poisonous gases in a burning mine. As a result of the experience of its engineers the Bureau of Mines recommends the use of self-contained oxygen-breathing apparatus by men doing rescue work in mines. If such apparatus is not available, it is preferable to enter the mine without breathing apparatus rather than to trust to other types of breathing appliances. The Army gas mask would give the wearer in the mine a false sense of security by removing distasteful fumes from the air breathed and allowing the carbon monoxide to pass through unnoticed. The smoke and gases from fires in mines serve to warn the workers of the presence of dangerous gas.

Detailed information regarding the utility of various types of gas masks and breathing apparatus in the presence of poisonous and asphyxiating gases encountered in fighting fires and in burning mines is given in Technical Paper 248, which may be obtained from the Director of the Bureau of Mines, Washington, D. C.

Testing Thermometers

A NEW edition of Circular of the Bureau of Standards, No. 8, entitled, "Testing of Thermometers," contains general information of interest to those who desire to submit thermometers to the Bureau for test. Brief sections are devoted to the following topics: The standard scale of temperature; types of thermometers accepted for routine and special tests number and choice of test points; test requirements and tolerances; certificates and reports for laboratory thermometers; reasons for refusal to test or to certify; notes on the breakage of thermometers; general instructions to applicants for tests; behavior of thermometers; and schedules of fees.

This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.



Left: Small boat equipped to chlorinate the water of a large swimming pool. The engine exhaust is used to counteract the refrigerating effect of the released gas. *Right:* A small amount of water is pumped through the chlorinator, is charged, and then flows off at the stern

How Washington, D. C., keeps its immense new swimming pool fit to swim in

New York City's Stat

Greatest Pier Project Ever Planned or Built at On

This view shows the fine stretch of twelve new city docks at Staten Island. The space between the new and old bulkheads is being filled in for tracks and warehouses

THE greatest single addition ever made to the pier capacity of the port of New York (or of any other port, for that matter) is the long stretch of piers, none of them less than a thousand feet in length, which extends along the shore-line of Staten Island to the south of St. George's Ferry, between Tompkinsville and Clifton. This is an entirely new development, all of the piers having been constructed simultaneously, and well within a stretch of two years' time. In width they vary from 125 to 200 feet, and in length from 1025 up to 1180 feet. The two widest piers, each 200 feet in width, and 1029 feet in length, carry double-deck sheds; the others are single deck.

The inauguration and putting through of this great municipal improvement is due to the former Dock Commissioner, Murray Hurlburt, to whose efforts, when he was a member of the House of Representatives, is due also the appropriation of forty million dollars, which is now being expended in blasting out the various reefs in the East and North rivers, for the purpose of securing a uniform depth of forty feet. Work upon the new docks was commenced in May, 1920, and was practically completed at the close of 1921.

In order to secure the benefit of deeper water and also to increase the area of level ground at the in-shore ends of the piers, a new concrete bulkhead was built one hundred to four hundred feet out from the old shore-line. The intervening space is now being rapidly filled in, and will be utilized for the construction of warehouses and other buildings appropriate to a great terminal such as this. Also upon this made ground, and upon the adjoining shore, will be established the large trackage which will be necessary to accommodate the ten to twelve million tons of freight which these new piers will be capable of accommodating in times of active shipping operations. The situation of the piers and the position of the old and new bulkhead lines are clearly shown in one of our airplane views of the whole dock improvement.

Although these piers have been criticized on the ground that most of them are of insufficient width, and because they carry only single-deck pier-sheds, the city authorities have stated that these two features were incorporated in response to the wishes of the steamship companies who were to become the lessees of these piers. The plans were submitted to them, and the dock commissioner was informed that these were the kind of piers that these companies wanted. It should be noted that one great disadvantage which hampers operation of most of the existing piers of the port of New York has been avoided in the Staten Island docks. We refer to the fact that a clear width of three hundred feet has been provided between adjoining piers, thus affording ample room for the use of lighters alongside the shipping, and on both sides of the ships, if need be, at the same time.

Forty-four Acres Additional Pier Space

How great an addition to the pier accommodation of the Port has been afforded by these new works will be realized, when we state that the surface of the piers represents an aggregate addition to the city's pier capacity of forty-four acres; which represents an increase of the city wharfage, suitable for transatlantic shipping, of nearly twenty per cent. The freight capacity of the twelve piers is estimated at fourteen million tons a year, which means that they can accommodate fourteen hundred 10,000-ton freight ships. Provision has been made for extending railroad tracks down each side to the ends of the double-deck piers, which will accommodate thirty cars at a time on each side. This means that freight can be discharged direct from car to ship, or from ship to car, or, if it be desired, direct to either deck of the pier-shed. Because of the great length it will be possible for two 500-foot ocean steamships to berth at one time on each side of the piers.

Piers Served by Electric Cranes

As will be seen by our illustration, the double-deck piers are served by eight Gantry cranes on each side of the pier. These cranes will have a capacity of lifting 2½ tons with a single fall, and 5 tons with double lines. The outer legs of the gantry run upon rails parallel with the edge of the pier platforms, and the inner end of the gantry travels upon a rail carried along the face of the pier-shed. These cranes can thus be moved to a position opposite any desired cargo hatch of a ship. Their booms can swing through 180 degrees, and cargo may be moved from ships' holds to the dock, or to the cars, in either direction. With an average load of 1500 pounds in a sling, each crane is geared to sixty cycles an hour, a cycle being the time from lifting a load until the load is laid down. This means that each crane can transfer 45 tons of freight an hour, which the Dock Department claims is double the average freight discharge at the present Manhattan Steamship piers. On the single piers two tracks for freight run down through the center of the sheds, and they are served by a dozen electrically operated deck winches and cargo masts.

The Storage Warehouses

We have referred to the group of warehouses which will be built on the filled-in ground at the inshore ends of the piers. To serve these, tractors, hauling six to eight trailer cars, will carry the freigh between the piers and the warehouses. On the double-deck piers, ele vators of 12 tons capacity will lift loaded trucks from the lower to the upper floors. At the shore-end of the piers there will be truck and car scales. The equipment of the larger piers will cost about $900,000 each, and the small piers will be equipped for about $450,000. A coal and oil bunker pier will be built convenient to the system, so that ships may re-fuel without loss of time.

An essential part of this development will be a generating plant for light, heat, power, and refrigeration. All the cranes, winches, and elevators of the 12 piers will be electrically operated by power dis tributed from this station. In short, no feature that characterizes the equipment of the latest and best of the great dock systems of the world will be wanting in the Staten Island improvement when it is finally completed. The total outlay for the piers, and their upland approaches, will be about $50,000,000. Evidently, if the port of New York is to reap the full benefit of this great improvement,

Details of one of the two-deck piers at Staten Island. These piers, over 1000 feet long, can accommodat on each side, of five tons

ity's Staten Island Docks

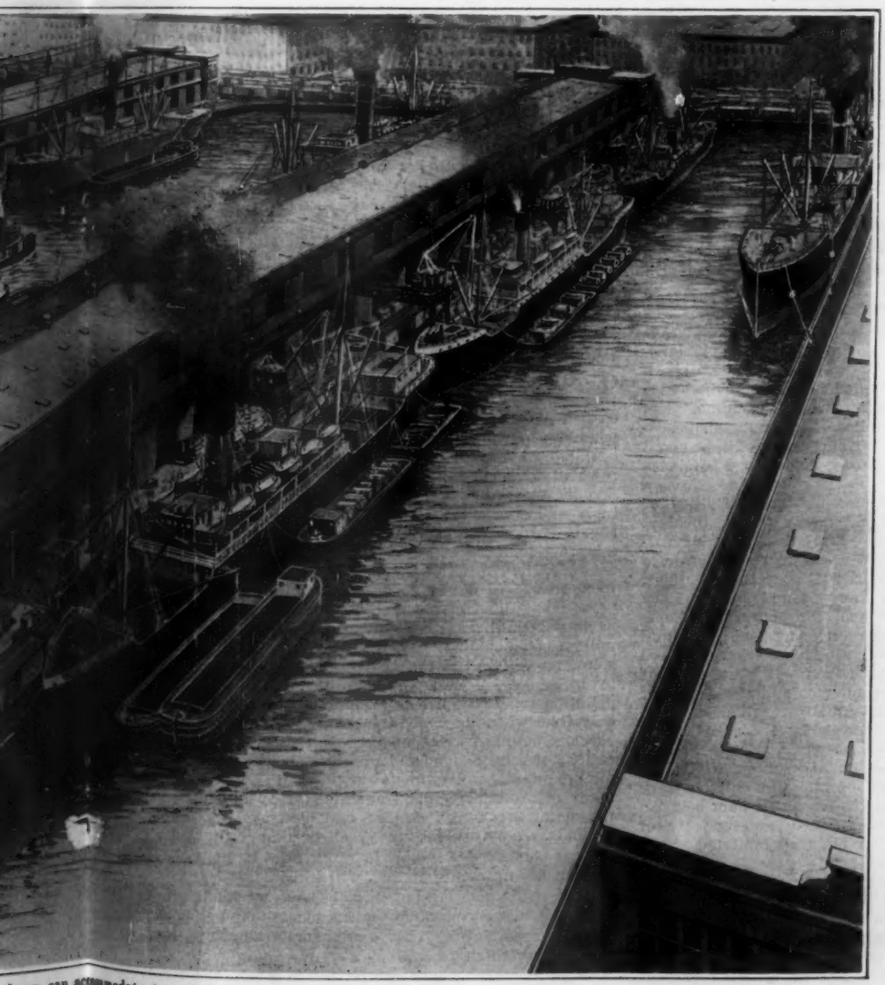
r Built at One Time in the History of Ocean Navigation

it must be adequately connected, not only with the trans-continental railroads that reach New York, but with the various sections of the great metropolis itself. At present there are two schemes that have been proposed—one by the Port Authority, and the other by the City Administration. The Port Authority plans to build an inner belt line about a mile back from the New Jersey waterfront, which shall intercept all the roads which reach the Jersey side of the Hudson River from the west and south. This belt line will be connected with a freight tunnel, which will pass under the upper bay to Brooklyn; and an extension of the belt line will be carried across the Arthur Kill and down to Stapleton and the new docks.

The other connection, as proposed by the City Administration, calls for a belt line sweeping around through New Jersey, at a distance of 20 miles back from the Hudson River, crossing the Arthur Kill not far from Tottenville, and running down through Staten Island to the new docks.

Whichever plan is adopted this much is certain, that the very first construction undertaken should be that of making the necessary first-class heavy track connections with this great $50,000,000 improvement of the city. Until such connection is made, it will be impossible to reap the full benefit of this great outlay of the city's funds.

Airplane view of two of the Staten Island docks, showing the wide basin between them—a characteristic feature of this improvement



long, can accommodate two 500-foot ships on either side. They are served by eight electric gantry cranes each side, of five tons capacity

Waterproofing Fabrics by the Aid of Electricity

FOR many reasons it is important that the clothes we wear or the fabric that we use for industrial or domestic purposes be able to resist the passage of water through its texture. Originally there was just one way of making cloth waterproof, and that was to impregnate it with rubber. This is known as the mechanical method of waterproofing; and while it is still used and possesses many advantageous features, it is not suitable for making waterproofed garments, as anyone who has worn a rubber coat will testify. There is no ventilation possible in such a coat, and its wearing leads to bodily discomfort.

The chemical process of waterproofing, which consists in precipitating an aluminum soap on the fibers of the cloth, affords good ventilation and is used largely in making waterproofed fabrics for fashioning into garments. The process is simple and consists merely in soaking the cloth in a highly concentrated soap solution and then passing it through a solution of an aluminum salt. A reaction takes place whereby the aluminum soap is precipitated on the fibers of the cloth, and as this substance is insoluble in water, the cloth is waterproofed. The disadvantage with this method is the coating of aluminum soap dries and crumbles away from the fabric. The ability of the cloth to resist water is then destroyed.

There is a process which is being worked successfully in this country at the present time in which the electric current is used in the waterproofing of cloth. The process is based on the use of the current to electrolyze a solution of the aluminum salt in which the fabric, which has been treated with the soap solution, is introduced. The claim is made that by this process not only is the surface of the cloth given a coating of the aluminum soap, but the inner capillary structure of the fabric is filled with the soap as well; that is, the interspaces between the fibers are closed up with this insoluble material. The process consists in passing the fabric, which has been treated previously with a solution of a sodium soap, between a graphite cathode and an aluminum anode which is entirely surrounded with a heavy woolen pad. The solution of aluminum acetate flows over the cathode. The woolen pad secures a uniform degree of waterproofing.

Various changes have been made in the arrangement of the parts of the apparatus which is used to accomplish this waterproofing action, and lately the main difficulty, that of getting over the seams in the cloth, was overcome by relaxing the pressure on the rolls automatically when the seam is reached. This was done by an adjustment of the spring pressure forcing the rolls against the fabric. When the seam is reached the graphite bar electrode was made to move backward and upward, and after it had passed the bar dropped back into its original position automatically.

After passing through the first electrolyzing bath the cloth enters a bath of water, where it is well washed, and then it goes through squeeze rollers which squeeze out the water, and into a second electrolyzing bath, in which the position of the electrodes is reversed, the anode plate being on top and the cathode bars below. This serves to subject the under side of the fabric to the waterproofing action. Silks and woolens require only two treatments, while cotton goods must be put through four separate electrolyzing baths. Fabrics that have been treated in this manner have been put to severe tests and have proved to possess remarkable waterproofing properties.

Cutting Fluids

THE selection of a proper cutting fluid is a very important matter in connection with work in the machine shop. The lubrication of the tool and chip in turning and similar work is a difficult problem, as the pressure between the surfaces of the tool and chip is high; and as the surfaces of the two metals are naturally very clean, there is a pronounced tendency to seize. This is particularly true of soft steel and wrought iron.

Recently the Bureau of Standards has conducted a thorough investigation of this subject, consisting not only of laboratory work but of extensive correspondence with users of cutting fluids to obtain the consensus of opinion of those well able to judge the relative merits of various fluids in practical work.

Technologic Paper No. 204 of the Bureau of Standards has been issued covering this investigation and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents per copy. The paper is divided into two parts, theory and practice, one covering the bureau's work on different classes of fluids, and the other detailing the results of correspondence with various users. Among other things, it is pointed out that viscosity should not be the controlling factor in the choice of a good fluid. Adhesion is a very important point, and in addition the substance must exercise a marked cooling effect on the work. The advantages of lard oil and blends in which mineral oil may be compounded to resemble the former product are described. The paper will interest those engaged in machine tool work.

The Ductless Glands

Recent Discoveries Concerning These Mysterious Regulators of the Human Organism

By Hereward Carrington, Ph.D.

THE past few decades have seen enormous progress in various branches of biological research—particularly in the investigation of the *mechanism* of the bodily and mental activities. Anatomy had progressed to a point where the detailed structures of the body were subject to the minutest investigation. But the question of the activities of the body functioning as a whole, was still subject to much doubt; and little was known of the nature of the dynamic forces which were at work in the actual operation of the body and its various separate organs.

It may be admitted at once that much is yet to be learned concerning these various processes. Science is as yet on the very fringe of the innermost recesses of life; and, while much has been discovered as to the body itself and its grosser forms of activity, little is yet known as to its "finer" activities, and those subtle energies which are manifested under abnormal conditions, or, for that matter, even during its ordinary processes of functioning!

Nevertheless, great progress has been made, particularly within the past few years; and this is nowhere more manifest than in the recent researches upon the activities of the ductless glands. The functions of the ordinary glands of the body, such as the salivary glands, the sweat glands, etc., have been long understood. All of these glands are provided with minute canals, or "ducts," which lead either to the exterior of the body or into the internal blood-stream, and secrete certain substances whose nature has long been known. In addition to these, however, we possess certain "ductless glands," so called because they do not possess any canal or duct which conveys their secretion either to the outer world or into the blood-stream direct. These glands have recently been shown to possess extreme importance; and, though they are very minute, their functions have been shown to be so necessary that without them we should soon die; and, on the other hand, without them we should never have been enabled to grow-up into sane, normal human beings. These glands of internal secretion may be classified as follows:

The *thyroid* gland, situated in the neck, producing a secretion named "thyroxin," whose function it is to control the rate of energy-production in the body, and also the growth of certain organs and tissues, particularly those connected with brain and sex. Over or under-functioning of this gland produces certain abnormal conditions which have been studied extensively by physicians.

The *pituitary* gland, which is a tiny gland situated about the center of the brain, within a bony couch or cradle—forming, as it were, a skull within a skull. (This shows the importance which nature attaches to this gland, in thus doubly defending it against accidents.) Small as it is, this gland has been shown to be divided, naturally, into two portions, the *anterior* and the *posterior*. The anterior pituitary secretes a substance known as "tethelin," which controls the growth of the skeleton and general supporting tissues. The posterior pituitary, on the other hand, produces a secretion known as "pituitrin," which governs or controls certain nerve-cells and involuntary muscles, and the brain and sex-tone. The gland as a whole, in its activities, is also thought to govern the energy consumption of the body—just as the thyroid controls its production.

The *adrenal* glands, situated over the kidneys, are also divided into two portions, the outer and the inner, known respectively as the "cortex" and the "medulla," like the brain. The adrenal cortex produces a certain secretion, known by its effects, whose ultimate or chemical nature is as yet unknown, but which seems to control, very largely, the growth of the brain and the sex-glands. The adrenal medulla, on the other hand, secretes a substance known as "adrenalin," which is perhaps best-known to the general public of all these internal secretions. Adrenalin is that secretion which, when poured into the blood, fits the body for emergency situations, which may arise through combat, flight, etc.

The *pineal* gland, also situated in the brain, was long thought to have no important function. The exact nature of the secretion produced by the pineal is unknown. But it has been shown by numerous observations that it has at least three important functions: brain and sex development; puberty and adolescence; maturity and the reäction of the body to varying degrees of light.

The *thymus* gland, situated astride the windpipe, and over the heart, is the gland of childhood, and it is this gland which "keeps children children," and whose activities prevent them from maturing too rapidly. The nature of the secretion which it produces is as yet unknown, but it has been shown that after puberty its activities practically cease, and the gland itself virtually atrophies and disintegrates.

The *gonads*, so-called, are the particular glands relating to sex life. They are, in fact, the sex glands themselves—the testes in the male, and the ovaries in the female. It has recently been shown that, in addition to their normal functions and external secretions, they are also glands of internal secretion and that they produce substances which, absorbed by the blood-stream, influence the characteristics of the body and particularly the so-called secondary sex-traits or characteristics.

The *parathyroids*, which are situated in the neck, behind the thyroid glands, and which also secrete a substance whose chemical nature is as yet unknown, have been found to exercise a dual influence upon the body and its activities. In the first place, they control very largely the lime metabolism, and in the second place they influence the excitability of nerves and muscles, so that a reäction which, in the absence of the inhibitory function of this gland, would be in the nature of an extreme shock, is reduced to a normal, nervous muscular reäction. The lime activities of the body have been shown to be of great importance, even to the extent of possibly determining the difference between the masculine and feminine skeletons, since the male has been said to be an organism with stable lime metabolism, and the female one of instable lime metabolism.

Finally the *pancreas*, situated in the abdominal cavity, producing a secretion known as "insuline," has been shown to be the controller of sugar metabolism—so that abnormalities in the functioning of this gland are responsible for the disease known as "diabetes mellitus."

Knowledge concerning the functional activities of these glands has been acquired only within the last decade or two, and intensive work is still going forward in various parts of the world, in an endeavor to complete our knowledge of their important functions. It is now contended that the type and shape of the body, the stature and growth, the character of our hands, fingers and toes, the various facial types and expressions, the quality of the teeth, the character and coloring of the skin, the hair, the quality and color of the eyes, the nature of the muscles and the character of the sex life, of any individual, are all determined primarily and almost exclusively by the activities of these glands—the secretion of one gland, it is now believed, is counterbalanced to a great extent by the secretion of another gland of opposite and contrary characteristics—so that, in the normal human being, a balance or equipoise is maintained, and one set of functions or activities is not unduly stimulated at the expense of another.

Thus, when the thymus gland functions normally, it tends to prevent the child from growing mature at too young an age, and offsets or "antidotes," as it were, the secretion of other glands, notably the adrenal cortex, which tend to bring on premature puberty. Thus, a constant balance is maintained within the organism, and a normal human being, mental and physical, is preserved by the interaction of these various internal secretions, each playing with and against the other.

But perhaps the most striking characteristic of the "new psychology," based upon a study of the ductless glands, is that the character, personality and temperament of any individual are now thought to be due to the varied secretions of these glands! According to this new point of view, the brain has been developed as a specialized thinking organ by reason of the activity of certain secretions of the ductless glands, particularly the anterior pituitary. Our personality depends very largely upon *memory;* if there were no memory, there would be no personality. The mechanism of memory has been divided by different psychologists into various subdivisions, but these may roughly be divided into three group-factors—namely, recording, retention and reproduction (the latter including recognition). Materialistic psychology contends that memories are traces laid down in the brain, being recorded there somewhat in the same manner as music is laid down in a phonograph record; and it now appears that the thyroid may be chiefly responsible for the process of the laying-down of the memory trace. The pituitary, on the other hand, is said to be responsible for the *preservation* of the memory deposit. It is only natural to suppose therefore, that under these circumstances the varied personalities which we see about us are but expressions of the varying activities of the ductless glands, which show a predominance of one type, as opposed to another—thus constituting an adrenal personality, a pituitary personality, a thyroid personality, etc.

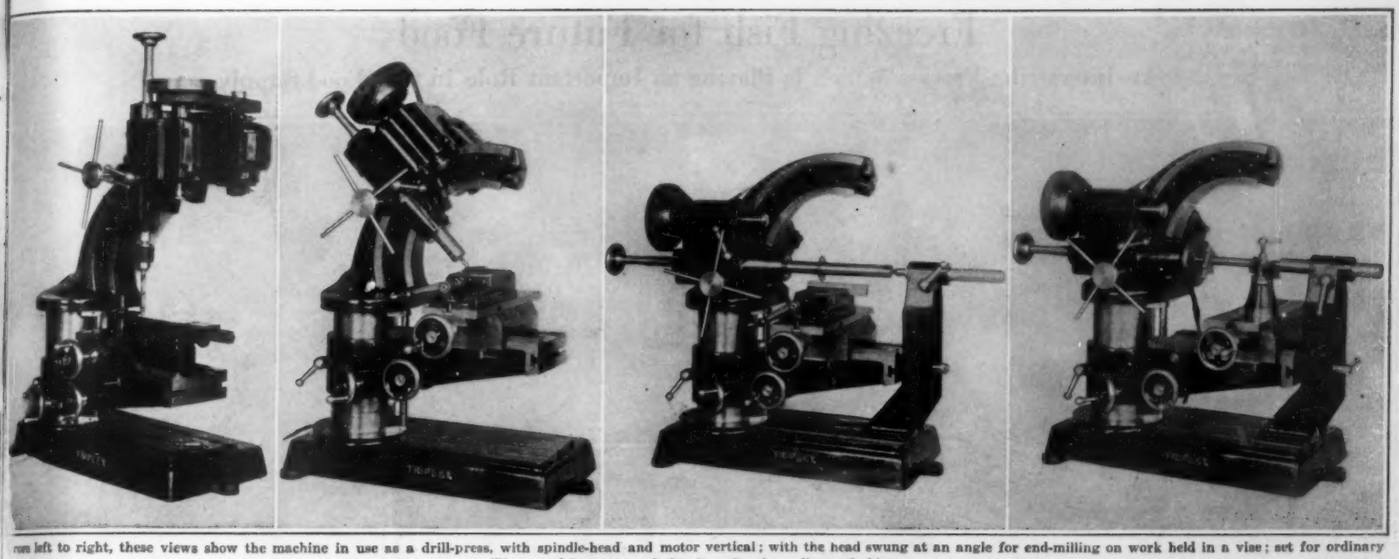
The aspect of the subject is, however, far more debatable than the purely physiological effects of these glandular secretions, which are now fairly well established. The theory that the purely chemical secretions of the ductless glands determine our entire mental and normal life, as well as our physical frame, may be questioned on several grounds; and until we know far more than we do at present of the inter-relationship of brain and mind, such extreme doctrines cannot be said to be adequately proved.

And this is quite true, even leaving out of the account the vast mass of "supernormal" phenomena—the evidence for which is being constantly accumulated in all parts of the world. It may be admitted, however, that these new researches on the ductless glands have thrown a profoundly new light upon the world-old problem of the nature of *life*.

DUCTLESS glands, in these days when it is the fashion to make startling discoveries about the human mechanism, are very much "in." We hear a great deal of them, and we might be inclined to wonder how in the world we ever got along without them—that is to say, without knowledge of them and of the part they play in the organism. Dr. Carrington attempts here a survey of the ground—he tells us just what these mysterious glands are, just what we know about them, and just what the more extreme authorities think about them. He closes with a word of warning against attributing to these glands, potent as we know them to be, more than is really their true function.—THE EDITOR.

A Menace to Fish Life

THE ever-increasing practice of discharging oil and tar wastes into streams and harbors, and its effect on fish and fish industries, is strikingly set forth in a pamphlet issued by the Bureau of Fisheries. The fatal contamination that results from poisonous substances rejected by gas plants and petroleum distilleries, or dumped from tankers and oil-burning ships, must result in huge losses of food products and money. First it should be distinctly understood that the presence of a minute quantity of poison is sufficient to kill. For example, the American sunfish, though highly resistant to poisons, will die in about an hour in water 4 to 5 parts per million of phenanthene or naphthalene, or 5 parts per million of hydrogen sulfide, or 7 parts per million of ammonia; and, of course, very much weaker solutions will kill if the fish are exposed to them for several days. Aside from this direct toxic effect, such pollution repels the fish from approaching shore at the only time when they might be caught; sickens or kills bottom-dwelling species such as oysters; kills, by suffocation, floating eggs and delicate larvae; destroys minute plants and animals on which the larvae and adult fish subsist; affects aquatic life by diminishing the aeration of the water; and destroys spawning grounds. Even petroleum products that contain no poisonous substance soluble in water may, by agitation, form a deadly emulsion that will kill in five minutes. Tarred roads also send their poisonous washings into the smaller streams. Remedial measures may be found in the commercial recovery of oils from drainage water, in the prevention of gas-house and refinery pollution with an increased use of wastes, and in regulations forbidding the dumping of oil from ships in harbors or near spawning grounds and feeding areas.



rom left to right, these views show the machine in use as a drill-press, with spindle-head and motor vertical; with the head swung at an angle for end-milling on work held in a vise; set for ordinary milling; and in use as a lathe, in quite the ordinary fashion

Four examples of the flexibility of the latest all-round shop machine

The Machine of All Work

A NEW combination bench-type machine which combines the lathe, milling machine and drill press has been recently developed by a New York machine-tool maker. The machine is motor driven and hand fed throughout, with the exception of the screw-thread-cutting operation. Anything that can be done on the bench lathe, the bench miller, or the drill press can be done on this machine. Among its great points of advantage are the adjustability for work at any angle. As one of our views makes clear, the head moves upon a graduated arc, and any desired angular adjustment is thus immediately available. At the same time the spindle can be fed out up to a distance of three inches by the handwheel that appears at the front of the head. Once fed to the desired point, it is locked in position by the lever that adjoins the handwheel.

The machine is motor driven and the motor is attached directly to the head so that power is supplied to the spindle when it is in either horizontal, vertical or angular position. There are six spindle speeds, the lowest being 90 and the highest 1150 r.p.m. These changes are obtained by shifting the shaft.

When the machine is used as a lathe, as in our fourth view, the spindle is made so as to hold either face-plate, spring collett, or chuck, so that a large variety of tools is usable. The three wheels for ordinary transverse, longitudinal and vertical feeding are grouped conveniently at the base of the arc on which the head travels. Micrometer dials are attached to all three, rendering the machine suitable for precision work. The carriage can be locked in any position. Tapers can be turned by moving the bed to the right or left of the spindle axis, and a lever is supplied to lock it in such positions.

When the head is swung up at an angle, as in our second photograph, and the milling operation is performed upon the work held in a vise, the tailstock is removed and the end mill is held by a spring collett in the spindle. The radial arm is graduated in half degrees, and swings a wide enough arc to bring it about that these half-degree marks are one-sixteenth inch apart, so that smaller units of a degree can readily be interpolated. The head is counterbalanced by a weight in the hollow column, connected to it by steel cables that run on pulleys.

Thread-cutting is done by the master screw method, no lead screw being used. The work is held in a chuck or spring collett, and while the spindle is revolving a handle bearing a nut segment is pressed in contact with the master screw, so that the spindle is caused to feed forward while the cutting tool remains stationary. At the end of the thread cut, the nut segment is thrown out automatically by the taper on the handwheel. The spindle is then returned to the starting place by handwheel. Internal threading is done in the same manner by using the appropriate internal-threading tool.

In our first view the machine is shown, with head and spindle vertical, in use as a drill press. Since the spindle is driven direct by gears a heavy cut can be taken when drilling, for there is no belt to slip. Vertical milling can also be done with the head in this position.

The machine permits of the bed being moved entirely out of the way for the accommodation of "cruel and unusual" work of any description. The base has three standard tee-slots to accommodate half-inch bolts. Horizontal, vertical or angular work can be performed on work placed on the base, just as though the bed were in use.

This machine is rigidly constructed throughout to withstand the heavy duty for which it can be used. It represents a complete equipment, admirably adapted for shops having limited floor space. It is well adapted for small production work requiring angular drilling or milling operations, since many extensive angular jigs and fixtures can be eliminated by using the radial arm of the machine, with the spindle feed feature. It is largely the motor drive that makes the angular features possible and eliminates all countershafting.

Train Lighting in France Must Be Electric

TECHNICAL journals report that the French Government has decided to eliminate the use of gas as an illuminant on railway trains. The Minister of Public Works and Transport, M. le Trocquer, has issued a circular which decrees that after January 1, 1923, no gas lighting will be permitted on express trains. On suburban trains electricity must be used for lighting after January 1, 1924, and by the first of 1925 all trains operating in France must be electrically lighted.

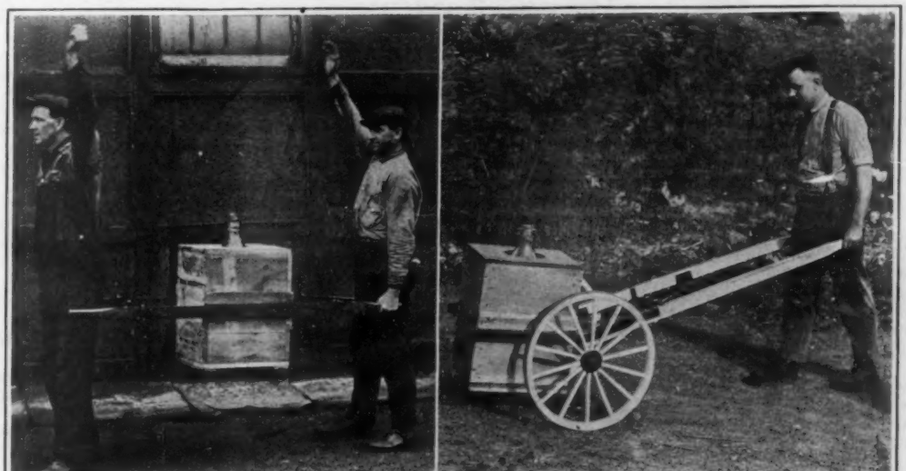
The French Government in 1914 contemplated the eliminating from trains of all lighting except electric, but action was delayed by the war. Recent train wrecks, however, where cars were set on fire through ignition of gas following upon collisions, have brought the matter to a head and emphasized the risk incident to the use of gas.

Safer Handling of Acid

EVERYBODY who has ever had anything to do with the handling of acid in the big, heavy glass carboys in which it ordinarily comes knows well that this is a delicate operation. Men do slip, do stumble, do encounter unexpected obstacles, even when they are walking in regular course, with no load, and on an apparently smooth way. When they are navigating in a factory, with its many corners and dark places, carrying a load of acid, they are more likely to meet with such an accident and it is a far more serious matter when they do so.

To take the peril out of a misstep on the part of the man who is packing acid about the premises, a Caldwell, N. J., equipment engineer has devised the carboy-carrier illustrated herewith. For all ordinary purposes the wheeled carrier is entirely practicable, and is, of course, to be preferred when it can be used, since it divorces the man in the shafts pretty thoroughly from the possibility of getting burned, no matter what happens to his carboy. The forks in which the carboy sets are sturdy enough to hold it up against a very powerful turning moment, and the use of two wheels in place of the wheelbarrow procedure which might have been a trifle cheaper affords a further safeguard.

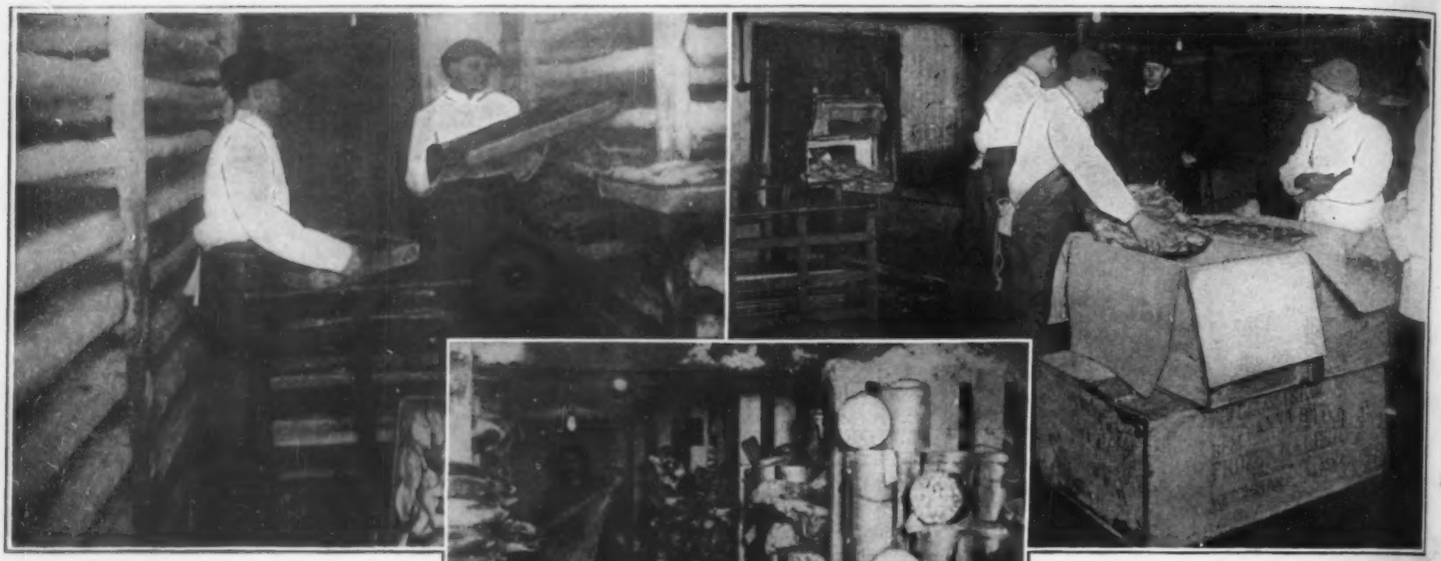
For trundling the carboy over a course containing too many obstacles to permit the use of the wheeled carrier, the extreme danger which such conditions necessarily imply is met almost as well by the two-man, two-handled carrier shown beside the other. The vastly improved stability got by this apparatus, as compared with more rough-and-ready practice familiar to all, is well exemplified by the little stunt which the two men in the picture are performing. If the carboy will not capsize under this provocation its suspension must be extremely stable.



With the one of these carboy carriers that is called for by the local conditions, the danger of accident in stevedoring acids is greatly reduced

Freezing Fish for Future Food

An Interesting Process Which Is Playing an Important Role in Our Food Supply



Left: Placing fish on ice-coated shelves of freezer. *Right:* Washing and panning fish before they go to the freezer. *Below:* Open storage of frozen and glazed fish

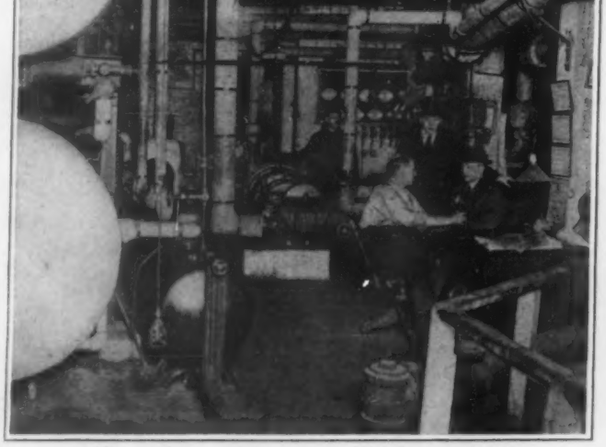
How large quantities of fish are stored, frozen, for future consumption

AMONG all the food industries which depend upon long-term preservation of some sort to distribute their seasonal product over the entire year's consumption none finds the storage for long periods more vital than the fish industry. Fish is perhaps the most perishable of all foods, as is evidenced by the care with which it is kept on ice even in the open display bins of the fish markets. And while some species are found all the year around, in many if not in most cases the season for the catch is a short one; nor is it limited by any factor under human control. The fish run when they run, and must be taken when they run. Varieties like salmon may be put up in cans, the process leading to a seasonal industry in which the problem is that of securing labor for the brief interval during which it is wanted. But more often it is necessary that the fish, when marketed, shall be whole fish and not mere canned fish-meat; and this requirement is to be met in only one way—refrigeration.

The primary source of the bacterial infection that spells decay is the gills; and all fish should have their gills and guts removed immediately on coming from the water. After this there is the necessity for keeping them in good condition aboard the fishing boat till the latter reaches port. This is often a matter of some days, even a couple of weeks. Ice packs and freezing in brine at low temperature are among the methods here employed; and the crux of the problem is getting the fish to the necessary low temperature without chilling them too suddenly.

When they are finally got ashore they may go on the market at once, or they may go into storage. In the latter event it is necessary to start all over again and prepare them for long storage as though they had never been chilled. Our photographs illustrate the principal differences in procedure here. The fish may be stored in open bins or shelves, in which event the prime requisite is that the carcasses themselves be thoroughly frozen. Cod, haddock, etc., are frozen until they are of precisely the consistency of a cake of ice; they are then covered with a glaze, and laid down for the needs of the future. Other species are sometimes packed with considerably more care, in a fashion which more nearly meets our ideas of what "refrigeration" consists in. In this case, instead of actually making a separate process of the freezing, the fish may be laid away in a freezing atmosphere and left to the natural course of events. Small stuff like scallops is frozen and stocked in pails.

In most of the commercial fish storage plants, as in other food storage industries, the old-fashioned ice-house has given way to the modern refrigerating plant, where cold is produced, not by the mere melting of ice, but by more artificial processes involving the actual use of power and fuel. Our grandfathers would doubtless be puzzled by what would appeal to them as a contradiction in the statement that our final picture represents the engine-room in a refrigerating plant. We, however, know what this means, and why an engine-room is necessary to maintain temperatures that are low enough to be unfavorable to the continued existence of the "bugs" of decay.



The engine room in a great fish-freezing plant

Copper May Harm Illusive Vitamine

ONE of the causes of the deterioration of the vitamine which guards against scurvy is the catalysis or chemical action due to copper pipes. This was illustrated recently by an experiment described in a recent number of the *Journal of Industrial and Engineering Chemistry* by Mr. Alfred F. Hess. He says that milk heated in a copper vessel will lose considerable of the antiscorbutic vitamine, as compared with milk heated in a glass container.

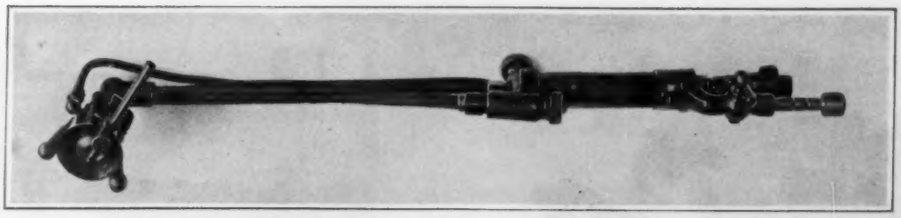
Guinea pigs receiving milk pasteurized in a copper vessel will develop scurvy, states Mr. Hess, whereas those who have been fed with milk which had been heated in a glass do not develop the disorder. That the signs and symptoms observed in the animals who had been fed with milk heated in copper were truly those of scurvy, was shown by the fact that they recovered when fed on orange juice. The milk so heated only contained three to four parts of copper to the million parts of the fluid.

"This experiment," continued Mr. Hess, "has a very practical application, for it is well known that milk in process of pasteurization passes through copper pipes. It is true that they are lined, but the lining frequently becomes defective after a short period. Lined copper vessels are commonly used in the course of condensing and drying milk. It is therefore not astonishing that copper is found very frequently in small amounts of milk. In a British medical report it was found 11 times in 87 samples. It is impossible to state how important a factor catalysis is. But whatever may prove to be the scope of its application, an experiment of this nature shows the little suspected factors which may be introduced and which must be taken into consideration in relation to the destruction of this most delicate vitamine, and warns us that in the handling of food products containing vitamines we must consider the influence of every new industrial process.

"Quite apart from the question of the destruction of the vitamines, the last few years have demonstrated that we should not consider foodstuffs as entities from the standpoint of their vitamine content. A food may be rich or poor in this factor according to attendant circumstances. For instance, carrots cannot be classed as containing a definite amount of antiscorbutic vitamine; if they are fresh they will contain much more than if they are old; or, again, if they have been plucked young they will have far more than if they were tough and old. We must avoid cataloguing foods too rigidly. It is probably of aid to arrange them in categories and to assign them definite potencies, but we must remember that such a list possesses merely comparative and approximate value." Contradictory and puzzling results in vitamine investigations may receive much light from all this.

A Match That Lights Under Water

"HAVE you got a match?" would seem a singular question under water, yet a Paris inventor has found a way to strike a light even there. If you should ask him what it is that can be lighted under water, he would say that gas pressure torches are now made to burn under water. Such are in fact the oxy-acetylene torches which are used for cutting up the iron plate of sunken vessels by their great heat. The great pressure of the gas prevents the water from putting out the flame, for it cannot reach the burner. But it may happen, of course, that the flame would go out by accident, and the diver would then be obliged to come up to the surface. With the new "match" he stays below and lights his torch. Certain metals such as potassium and others when placed under water will set up a violent reaction accompanied with heat or even flame. But other substances can be added which will aid in producing the flame, and if the proper mixture is packed into a small brass tube about the size of a cigarette and provided with a stopper, such as is seen just in front of the burner of the torch, all that is required when working under water is to pull out the stopper and allow the water to enter the tube, and the mixture then commences to burn amid the outrushing gas from the torch, so that we have exactly the same result as if a match had been applied above ground. A spring fixture holds the tube and also pulls it back out of the way of the torch flame when not in use.—*By Francis P. Mann.*



Under-water match with which the diver can relight his gas-pressure torch, if this should accidentally go out

Sun Worship

THE London *Times* recently carried a news dispatch which indicates that a pet theory of the late Sir Norman Lockyer has just received a blow from which it can hardly recover. Accurate measurements made by the Egyptian Survey have proved that never since the great Temple of Karnak was built has the sun shone straight down its axis. Sir Norman Lockyer believed that this temple, and many others in addition, were constructed for the purpose of obtaining an exact observation of the precise time of the solstice—that is to say, the day of the sun's most northerly setting. But Mr. Richards, of the Survey of Egypt, has proved that the sun has *never been visible at all*, at any moment in any day in any year along the axis of the temple, since about 6000 B.C., and that it last set along the central line of this axis between 12,000 and 13,000 years ago. At this date Europe was still in the Old Stone Age; the cave period was at its zenith, and the hunters of the Dordogne were chasing reindeer over the French tundras. To suppose that the Temple of Karnak can have been built then is out of the question. This would appear to dispose of the sun-temple hypothesis; and the Survey of Egypt is to be congratulated upon a useful piece of work.

Portable Runway for Climbing the Curb

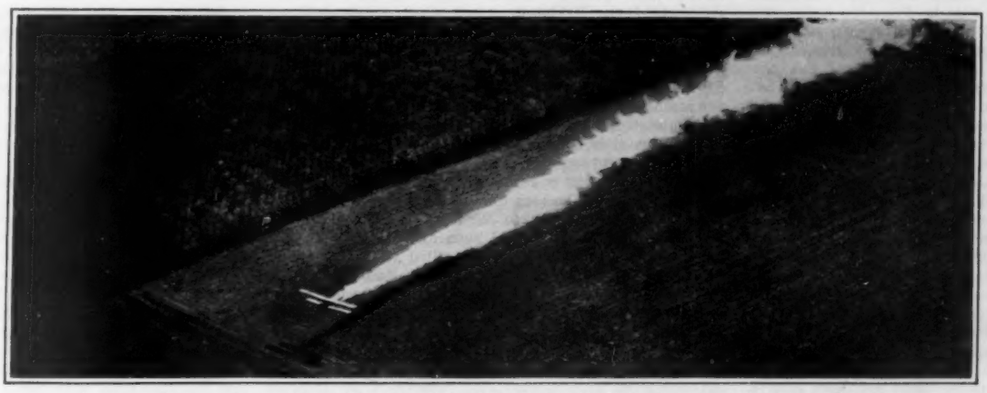
A RHODE ISLAND man has recently developed a device which will be found useful by automobile drivers who have to climb over curbings in order to get into garage or parking space. The device consists of two wooden runs which are connected in such a manner that they will fold together when not in use, so that they may be kept out of the way. Weighing only ten pounds, the unit is easily handled by any person; and when folded, its three feet of height does not take up much room. Its use is greatly to be preferred to the alternative of "rushing" the curb.—*By Allen P. Child.*

The portable runway to carry the car up the curbing, as it appears at the several stages of its use

Spraying Trees from the Air

IF we disregard the usefulness of the airplane in commerce and war, there still remains a list of applications lengthy enough to justify its development. But even the airplane has its limitations; there are things it cannot do, and every agency which has had anything to do with aeronautics has had scores of such "silly" proposals.

It is not to be wondered then, that practical flyers at McCook Field, the Army experimental station at Dayton, at once catalogued as in the "silly" class a proposal to spray trees from an airplane. When two flyers were assigned to the job of trying to do it, they undertook it with frank skepticism. It was not even considered worth while to make arrangements to photograph the "stunt." When the test was an unqualified success, there were no more surprised persons than the men who made it. They landed and telephoned back to the field for a photographer. He came—by air—and the test was performed again for the benefit of the camera,



Spraying from a plane: already the tail of the dust stream is beginning to settle among the trees

with the result shown here.

The proposal to try spraying trees from the air came from C. R. Neillie of Cleveland, who discussed it with H. A. Gossard, chief of the Ohio Department of Entomology. The cooperation of McCook field was asked in testing the idea. An airplane designer was assigned to the task of making some sort of apparatus for releasing "bug powder" from an airplane, and he made two sifters, on the principle of a flour sifter, arranged with sprockets and chain drive so that they could be operated from inside the plane. These sifters with flat hoppers were fastened on the sides of an airplane fusilage.

Mr. Gossard selected a grove of 500 catalpa trees on a farm near Troy, Ohio, for the test. This grove was literally "alive" with a species of caterpillar which twice before had practically defoliated the grove. The plane was piloted by Lieut. John A. Macready, who a few days later set a new altitude record, and E. Dormey, who designed the sifters, went along to operate them. The hoppers were filled with arsenate of lead powder. The two originators of the idea were already stationed at the grove to watch the results.

Upon reaching the grove, the plane flew just above the tips of the trees along the windward side of the grove, Mr. Dormey operating his sifters. The arsenate of lead was carried by the wind over the grove and then it settled down gently among the trees. The observers in the grove declared that the dusting from above was much more effective than spraying for the reason that the dust started at the top of the trees and literally stripped the caterpillars off to the ground. Within a few moments after the "dusting" the ground was covered with dead caterpillars. The job, which would have taken sprayers three weeks, was performed in as many minutes!

Meanwhile the flyers had landed to find out the result of the test, and upon learning it they at once telephoned for a second plane with a photographer. The test was then repeated with equal success.

Mr. Dormey has designed a more efficient type of sifter, and it is proposed to test the idea further as occasion permits. These tests will be watched with much interest by forestry experts, especially in the East, where a similar scourge is working havoc.

Gases in Metals

THE wide field and great practical importance of exact knowledge of the gas content of metals is brought to our attention more and more frequently. Aside from the more or less familiar importance of gases as related to the deoxidation of steel and the production of sound ingots and castings, many operations in refining, working, and treating of metals are vitally concerned with the action or effect of various gases.

Many of the inherent differences in quality of steels made by different processes are generally attributed to the amounts and compositions of the gases with which the metal is in contact when in the molten state in a converter, open-hearth or electric furnace, or in a crucible. It is reported that steel converters operating in a vacuum have recently been successfully used on a commercial scale in England to produce cutlery steel of unusually fine quality. The presence and nature of occluded gas in cast iron has been said to be closely connected with two important characteristics of such material, namely, the graphitization of cast iron and the growth of gray cast iron.

Of no less importance are dissolved or occluded gases in nonferrous metals. For example, the fire-refining of copper is wholly a matter of intentionally dissolving a gas (oxygen) in crude copper and then removing nearly but not quite all of this same gas. If the final step of this refining is carried to the complete removal of oxygen by poling only a minute or two longer than necessary, the whole furnace charge must be entirely reworked as if it were a fresh charge of crude copper.

In the working and fabrication of copper, gases must be again considered. Operations involving the cleansing of steel or iron by pickling in acids must be followed by treatments designed to remove hydrogen taken up from the metals by the gases. If not removed, this occluded gas will make the metal too brittle to work or will give trouble in subsequent operations when the metal is exposed to heat, as, for instance, causing blisters in enamel. Occluded gases have also been shown to have a marked effect on the electrical conductivity of metals, their magnetic properties, their consistency in dimensions, as well as their mechanical properties of hardness, toughness, tensile strength, elasticity, etc.

Left: Repairing the expedition's sled. *Right:* America's northernmost clubhouse, at Nome. The northernmost theatre is to be found in the vicinity.

Two aspects of the (more or less) friendly Arctic

"The Friendly Arctic"

Its Well-Stocked Larder and How Three Men Lived Off the Country

WHILE yet a boy, Vilhjalmar Stefansson decided he was a failure as a North Dakota farmer, so he went to college and became an anthropologist. All the world now knows him as an explorer and writer, and it is hard to say in which rôle he is at his best. His latest book, published by Macmillan, tells the story of five years in the polar regions. We owe the illustrations to the author.

On his second Arctic expedition Stefansson discovered the blond Eskimo and added to the map of Canada; perhaps these successes went to his head, for about this time he developed a startling idea. This was no less fantastic a notion than that a man should be able to travel the most inaccessible and desolate stretches of the North unencumbered by food and fuel, living on the country as he went. Incredible as it may seem, he managed to enlist the interest of both the American and the Canadian governments in his plan, and the latter eventually fitted out and financed for him what is known as the Canadian Arctic Expedition. This included three ships and a scientific staff of fifteen men, the pick of the civilized world.

Nome, Alaska, has the distinction of possessing the most northerly clubhouse, and the most northerly theater, in America. The three ships left here late in July, 1913. A party left the "Karluk" and walked ashore on the ice to Cape Smythe, where the land was grass-covered and prairie-like, and birds twittered and mosquitoes buzzed; this was disappointing to Dr. Mackay, of Antarctic experience, but he was promised blizzards and low temperatures later. Soon after this the "Karluk" was caught in the ice and, while Stefansson and a hunting party were ashore near the mouth of the Itkillik River, she disappeared with the supplies and photographic and scientific equipment aboard. Passing quickly over difficulties and misfortunes that included a mutiny of the leaders against Stefansson's authority, we come to the time when, a month late, he and two companions, Storkerson and Andreason, started from Martin Point with one sled and six dogs for their journey into the unknown. They had full rations for the men for thirty days, and dog feed for about forty days; they had also two rifles and six gallons of kerosene for quick cooking on a blue-flame stove, besides the hunting gear, the necessary bedding and the scientific equipment. Gales and ice-crushes enlivened the earlier stages of their journey, and the scarcity of game signs worried them. During the first ten days of May, their kerosene was exhausted, and they went on half rations, for in their fast travel toward Banks Island there was no sight of a seal; it was at Banks Island that they expected to find the "Star."

Contrary to popular belief, the problem of drinking-water was non-existent. Sea ice becomes fresh during the period intervening between its formation and the end of the first summer following. Food and fuel were what they must have; and when they paused long enough to make a conscientious search for signs of seal —they found them! A seal makes a breathing-hole by poking his head up through newly formed ice, and all he has to do then is to see that this hole is kept open. Months after the breathing hole has been abandoned, a distinct ring on the ice shows that seals have been there. But Stefansson's party did more than find signs; they found the seals. From then on starvation no longer dogged their thoughts, and three men, "one crazy and two deluded," had vindicated their faith against the opinions of noted explorers and the convictions of the Eskimos. After ninety-three days on drifting ice, a journey of nearly 700 miles, the little party landed on June 25th; the chart showed the land as Banks Island; it was really uncharted land which Stefansson named Bernard Island, a mile or two from the mainland. The summer was spent on Banks Island; by September 11th the party reached the Cape Kellett base, where they found the "Mary Sachs" instead of the "Star." Stefansson had long been given up for lost, and the excitement caused by his arrival was intense; he was told that the men on the doomed "Karluk" had safely made their way to Wrangel Island. Later, it was learned that many had been lost.

The winter of 1914–1915 was filled with busy preparations for the spring exploratory work. Prince Patrick and Banks Islands were mapped; the most northerly point attained by McClintock was reached, and new land discovered beyond it, after which the party turned south and crossed Banks Island, reaching the Kellett base camp on August 9th. Here Stefansson was, according to the newspapers, "rescued" by Captain Lane's "Polar Bear." The rescuers insisted on feeding him, though his only hunger was for news. It was then that he learned for the first time of the Great War that had been raging for a year.

The following spring the expedition occupied itself with the Ringnes and Christian Island group, and found that the huge island known to mapmakers as King Christian's Land does not exist. A small island, for which this name has been retained, is separated from the larger Findlay Island by a wide strait designated on Stefansson's corrected chart as MacLean Strait. Much good work was accomplished in this region.

This may be lonesome, but Stefansson did not find it unfriendly

In the five years that Stefansson spent in the Arctic, he mapped and explored more than 100,000 square miles of hitherto unknown territory, secured material of the greatest scientific value, and dispelled many illusions relating to Arctic conditions. Neither as explorer nor as anthropologist is he content to rest upon the obvious, which is so often the false. As to anthropology, his keen perception and careful deductions are well instanced in his handling of the "age of maturity" problem. The age of maturity, so authorities tell us, comes earliest in the tropics and increases as we traverse the temperate and frigid zones. Yet it is not rare for an Eskimo woman to have her first child at the age of twelve; here we have what seems a marked exception to the rule. Stefansson, however, remarks that the Eskimos unspoiled by civilization live a great part of their lives in a climate whose temperature is from 80 to 90 degrees Fahrenheit. That is what a thermometer in one of their snow houses registers; and when they go into the open they are clad in two layers of fur that must maintain the body heat at a tropical point; in short, indoors or out, the Eskimo and the Sicilian live in the same climate. But our anthropologist does not rest here; he observes that the natives who have come under the influence of civilization, and who live in porous houses and dress in porous clothing, mature much later. Among the northern Indian tribes, who live in wigwams and are poorly clothed, the age of maturity is quite as high as among the north European whites. Thus he accounts for the apparent exception to established theory.

His visit to the Copper Eskimos near Phayre Point reveals the hospitality and child-like friendliness of these people, as well as their resentment toward being treated as inferiors. Stefansson himself was regarded as a magician, and was loved, respected, and a little feared. On his arrival at a village, the men at once built him a snow house on a site of his own selection. Trading was usually carried on in an atmosphere of high good humor; but when a subordinate of Stefansson's took an attitude of superiority, they robbed him of his goods. Later, these were either returned or paid for; but whether this was due to repentance or a wholesome fear that Stefansson, the magician, would send sickness upon them, is an open question. The Eskimo dislikes anything very hot, and more hot food is eaten in summer than in winter. The phonograph failed to interest them; it was just a miracle which they accepted as readily as any other miraculous happening, and they would drift into talk of the fleshpots while it was playing. Stefansson is insistent on the warm, well-nourished and happy life of the Eskimos; and, with one roguish eye cocked upon the missionaries, he remarks that, "It is one of the anomalies of our world that it should take the efforts of so many self-denying people to awaken the wretched to a consciousness of their wretchedness."

To Stefansson, going toward the polar pack is like going home, and he has other ideas about the north that are just as surprising. That impressive phrase, "the silent north," only arouses his laughter. The sum-

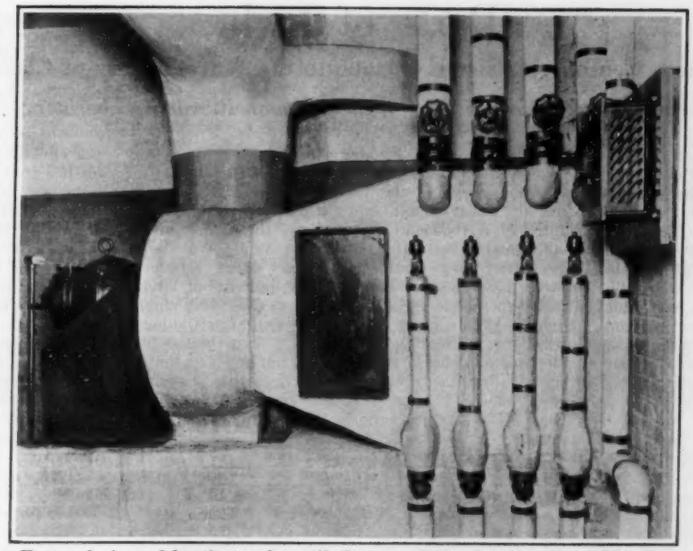
mer days, he says, are full of the hum of blue-bottles, the buzz of mosquitoes, the cries of plover, snipe and sandpiper, the squawk of ducks and many other noises, while the nights hold the demented screams of the loons. Near the sea, as ice is being piled against the coast, the cakes slide over one another with a high-pitched shrieking sound, followed by crashes as cakes as big as a church wall up-tilt to topple down in ruins. The buckling up and snapping of great floes adds a groaning "as of super-giants in torment." He objects to the word "desolate" also; all that he will concede is that trees are indeed not plentiful, and that there may be snow on the ground. But if you call that prospect "desolate" or "dismal," it is simply because your habits of life have accustomed you to trees and bare ground. Nor will he admit that Arctic exploration is a continuous round of hardships; if you know how to hunt seals and to find your way by the patterns the prevailing winds fashion upon the ice, suffering can come only as it comes to all men, everywhere—by carelessness and by accident. He is convinced, too, that the "well-brought-up" young man makes the better explorer, since he finds him more adaptable to a strange environment. If you will conform to the ways of the north, he repeats, you will find it exceedingly friendly and homelike.

From these assurances the average reader will turn to the author's accounts of up-ended blocks of ice, their heads, fifty feet high, over-hanging the camp; of marauding polar bears, shot in the middle of their spring, and spattering the gunner with blood; of painful progress across the ice, vividly described as being a mean between wading and navigation; and of various other episodes not reassuring to the timid man. However, Stefansson is not claiming that the Arctic is friendly to the tenderfoot, and he certainly upsets many of our preconceived ideas of eternal silence, universal desolation, and continuous menace.

Stefansson, with his fresh viewpoints, carefully thought-out theories and unselfish courage has raised polar exploration from a cross between an art and a sport to something like a science. If the Challenger expedition discovered a new world at the bottom of the sea, the Canadian expedition found a well-stocked larder beneath the northern ice. His narrative so teems with virile life, suggestive observations and significant discoveries, that it is impossible to pick out even the high lights in a brief summary. Only the man who has read it can appreciate its epic quality; to him it brings the exaltation of wide, airy spaces, fresh-air humor of the most genuine quality, and accurate knowledge in place of a mass of misconceptions.

Heat and Ventilation for the Cow Stable

POWER-DRIVEN ventilation for the cows is the latest note in dairy farming. The installation we illustrate is from the establishment of one of the wealthiest of the "gentleman farmers" in the New York suburban territory, and we do not know whether in its present form it would pay its way on a dairy farm that had to meet its expenses out of its receipts; but it looks sufficiently plausible to lend the thought that it might.



External view of heating and ventilating apparatus for the cow stable of a large dairy farm near New York

The pipes carry steam into radiators which are located inside the big retort-like enclosure. Heat from these radiators is forced upward by a fan inside this big box, the motor at the left driving this fan. The heat passes up over the tile ceiling in the cow barn, where it is thrown out through air passages that resemble the ordinary registers of the conventional hot-air heating system. The force from the electric fan is sufficient to drive the heated air out of these and down over the cows; and it passes out through passages in the floor. This equipment renews the air in the entire building every four minutes. The idea, of course, is to get more and better milk and butter from the cows by making the animals comfortable; and so far as it can be tested out on a farm which is not obliged to effect a commercial success, it seems to be a valid one.

Emergency Houses of Clay and Straw

THE housing problem, sufficiently acute in this country, is far more pressing in many sections of Europe. The difficulty here seems to be more a matter of general business conditions and bad practices in the building trades than anything else; in France and Germany it is rather the difficulty of securing proper materials that is interfering with the return to normal building. Accordingly, any means of substituting cheap and homely materials for the customary ones is of great significance to the European sufferer from the housing shortage—of far more significance than we in America, on casual thought, might imagine.

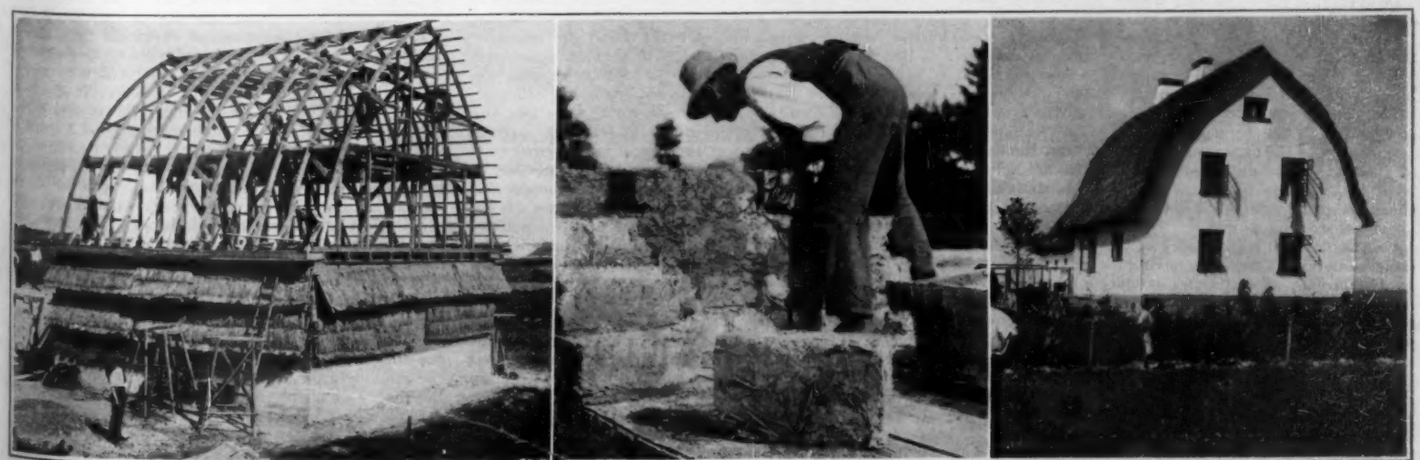
Both in France and in Germany means are being devised for cutting the Gordian knot along the lines suggested by this remark. Wooden framing must be had, of course; in its absence nothing worthy of any better name than hovel can be attempted. It is in the selection of materials for filling in the wall spaces that ingenuity is displayed. We illustrate a development in Germany where ordinary clay, either in the shape of bricks or as a built-up, integrated mass, is applied to the framework to make the walls; and at the same time we are reminded of a French system, largely parallel to this, under which the principal material is straw, usually in the form of crude brick but in some cases partly as filling between an outer and inner layer of this brick.

In both cases the framework may be made surprisingly light, in view of the relatively light weight of the finished structure contemplated. The foundation, though it must be adapted to the nature of the ground in which it stands, enjoys the same advantage as the framework. It is covered with sheets of tar paper to prevent dampness. The blocks of compressed straw, which in the French scheme fill the spaces in the wooden framework, are shaped like bricks, but are much larger than the ordinary brick. Their length, in fact, corresponds to the distance between the uprights of the frame, and their depth to the desired wall thickness. After the walls have been completely filled out with these crude blocks of straw, both sides of the wall are covered with a fine-meshed wire net, on which outer and inner coats of cement in the one case and the plaster in the other are laid. In spite of the thickness of the walls—15 inches or more—the ensemble turns out to be of surprisingly light weight.

The German method of using clay appears to be somewhat more flexible. Obviously the clay can be merely substituted for the straw in the above-described procedure. Other possibilities involve the construction of the entire wall in what amounts when finished to a single piece, either with the foundation offered by the wooden frame alone, or with the further use of straw mats as suggested in one of our views. Then there is also the alternative of our second picture, where the framework is dispensed with entirely. The result here may be a hovel, as implied in a remark above; but it would be a very sumptuous hovel, we have no doubt.

Emergency Money in Italy

THE scarcity of small change in Italy has reduced the population to using postage stamps instead. These, however, are not a success, for after passing from horny hand to horny hand, foul pocket to foul pocket, they become even more black and greasy and germ-laden than the two-penny-halfpenny banknotes. And indelicate people are seizing the opportunity to palm off stamps that have already passed through the post. Ingenious tradesmen have accordingly combined advertisement with utility by issuing postage stamps in metal disks with a transparent front and the name of their wares on the reverse. Conditions illustrate the recklessness of the government, which deliberately neglects one of the easiest avenues of profit at a time when the national finances are in the shakiest condition.



Left: The finished framework as it stands before the clay is put on. *Center:* An alternative procedure for building the walls is to make them of clay bricks pressed closely together, instead of using a framework. *Right:* The finished clay house presents much the appearance of a brick dwelling

Clay houses that are being looked to for the solution of Germany's housing problem

Darts of Light

What Twentieth Century Physics Has Done to the Wave Theory of Classical Optics

By Dr. C. E. Kenneth Mees of the Eastman Research Laboratory

THE nature of light has been the subject of famous controversy. Newton, in subduing under the weight of his authority the wave theory of Huyghens, held that light consisted of discrete particles of matter shot off from the source, which bombarded the objects on which they fell and were reflected to the eyes of the observer, there producing the sensation of sight. This explains reflection very easily, and Newton was able with some difficulty to account for refraction, too. But what finally discredited the corpuscular theory was the phenomenon of interference. (See SCIENTIFIC AMERICAN, July 19th, 1919: "A Millionth of an Inch.") If light is corpuscular, it is difficult to see just how two streams of particles traveling in the same direction can possibly do other than reinforce one another.

This difficulty led to the formulation of the wave theory, which accounts as well as the corpuscular one for reflection and refraction, and better for interference and polarization. Adopted at the beginning of the nineteenth century, the wave theory of light has proved very fruitful, especially after its mathematical investigation by Clerk Maxwell, who showed that the waves could be treated as an electro-magnetic disturbance of the universal, hypothetical "ether." Recently, however, fresh phenomena have been observed which are difficult to explain under the classical wave theory, and it seems not unlikely that we may have to turn to a theory more or less analogous to the corpuscular one of Newton.

The origin of light emission is now ascribed, not to the molecules of matter or even to the atoms as a whole, but to the particles of negative electricity which are called "electrons" and which form a part of the structure of the atom. The atoms of the chemical elements are held to consist of a nucleus carrying a positive charge of electricity surrounded by one or more electrons carrying a negative charge, the whole atom, of course, being electrically neutral. It is thought that these electrons revolve either about the positive nucleus itself or about some other center, and on their number and the corresponding charge on the positive nucleus depends the nature of the atom.

The electrons are supposed to revolve without radiating, but when an electron suffers some violent shock, it gives up energy, and this energy is radiated in the form of waves in the ether. Thus, if an electron by the sudden impact of another electron, for instance, is thrown out of an atom and is attracted back to its place by the nucleus, then, as it falls back, it will send out a pulse of energy, and it will be seen at once that if light is produced by such a succession of shocks occurring to electrons, it is inherently probable that it will be radiated in pulses rather than continuously. These pulses of energy have the very remarkable property that the frequency of the vibration emitted is exactly proportional to the energy which the electron releases. The wave-length, of course, depends upon the frequency; the more waves there are in a given time, the shorter their length must be, since the velocity of light is constant. So when an electron loses a very little energy, it gives out long waves, and when it loses a great deal of energy, it gives out very short waves.

In an X-ray tube the discharge of electricity is in the form of a stream of corpuscles traveling with a velocity which is very high and which depends upon the voltage of the electric current applied to the tube. When these corpuscles strike the target their energy is radiated in the form of X-rays, and these partake very closely of the nature of light except that the length of the waves is about one-thousandth that of light or, what is the same thing, the frequency is a thousand times as great. It is to this that X-rays owe their great penetrating power.

On the classical wave theory of light, then, we should imagine that an X-ray tube having its target bombarded by the stream of corpuscles produced by the current would emit waves of X-rays spreading into space, just as waves of light are imagined to spread from a source. But now comes a great difficulty. When these X-ray waves pass through a gas and are absorbed, they cause the molecules of the gas to emit electrons, and these electrons are emitted with almost exactly the same velocity as the electrons in the tube which produce the X-rays themselves.

The extraordinary nature of this phenomenon is well illustrated by Sir William Bragg. He takes as an analogy the dropping of a log of wood into the sea from a height of 100 feet. A wave radiates away from where it falls. If the water were perfectly free from viscosity, and there were no other causes to fritter away the energy of the waves, they would travel indefinitely, always diminishing in their height. At some point, say a thousand miles away, these now microscopic ripples encounter a wooden ship. We should expect that they would produce no effect, especially as they have passed many other ships without having affected them, but, for some reason, as these tiny ripples reach the ship, a plank of the same weight as the log is hurled out of the ship to a height of exactly 100 feet, and the whole energy which was originally supplied by the log falling into the water is concentrated upon the ejection of this plank. It will be seen at once how inadequate the wave theory is to account for this phenomenon.

Very recently, new light has been thrown on this question of the radiation of light by the study of the exposure of photographic films. The sensitive surface of a film, which is called the "emulsion," consists of microscopic, crystalline grains of varied sizes, ranging from those which are visible only as specks under the highest powers of the microscope to crystals which are easily visible and show clearly defined forms. When these grains are exposed to light they become developable after they have received sufficient exposure, and under a wave theory of light the difficulty has been to see how they added up the light until they had enough. Imagine a film exposed under a telescope to the image of a star. At the end of five minutes' exposure, no grains at all might be developable, and no image of the star would be obtained. Nevertheless, some change has occurred to the grains if we accept the idea that they have been continuously exposed to light, because if we go on exposing, presently some of the grains will be developable, and after hours of exposure enough grains will be developable to make a good image of the star. Moreover, the grain stores these impulses with such security that if the exposure is interrupted for weeks and then started again, the grain will not have lost its record of the former exposure but will start practically where it left off.

FOR a decade or more it has been increasingly plain that something was happening to the classical wave theory of light; and if the relativity postulates of Einstein stand the test of time, this fact will be as evident to the layman as to the physicist. We ourselves have had numerous inquiries asking what theory of light propagation will be in harmony with universal relativity. To these queries we have replied in a general way that we do not yet know, but that it will evidently be something in the nature of a compromise between a wave theory and a corpuscular one. That science is actually moving in this direction, and is making some progress, is indicated by Dr. Mees in this account of the work being done by Dr. Silberstein.—THE EDITOR.

Another difficulty which arises when we study the exposure of the individual grains is that they appear to differ in sensitiveness; the bigger grains are very much more sensitive than the smaller. Moreover, if we sort out a number of grains, all of the same size and shape, under the microscope, they will not all become exposed at the same time; some of them will become developable before others, and if we imagine that they have all been exposed to a uniform flow of light, we must consider that these grains differ in sensitiveness among themselves.

If we had no prior knowledge of the wave theory of light, it is clear that the simplest explanation of the different sensitiveness of different grains would be that instead of a continuous flow of light in the form of waves on to the sensitive film, the light was falling upon it as a rain of projectiles, and that these projectiles made developable any grains that they hit, the grains which were missed not being developable but being hit later if they continued to be exposed to the radiation. Now, this assumption was made by Dr. Ludwik Silberstein, who is studying the problem in the Eastman Research Laboratory, and he was able to calculate the chance that a grain of any size would be hit by such a projectile and would therefore become developable. Naturally, the bigger the grains the more likely are they to be hit, so that a calculation can be made of the relation between the size and the number of grains which will become developable after a given exposure. When the experiment was tried, it was found that the bigger grains become developable more quickly, as compared with the smaller grains, than they should have done according to the calculation. It is possible to explain this discrepancy by several modifications of the simple idea. The first which Dr. Silberstein has suggested is that the projectiles are not infinitely small, but have an appreciable diameter varying over a wide range but of an average size comparable with that of a very small grain. If we make this assumption, then, from the rate at which the grains of different sizes become developable, we can calculate the average diameter of the projectiles of light, and this has been done.

Whatever the projectile of light is, it must be associated in some way with waves, because, as was said earlier, the frequency of the vibration emitted is proportional to the energy of the electron which produced it, and so, while we have gone back to a projectile theory of light, instead of the idea of a continuous wave front, we have not abandoned waves. Dr. Silberstein suggests that the projectiles rather than being called "corpuscles," which gives the idea that they are round, should be called "light darts" and should be imagined to consist of a long train of waves of very small diameter traveling, of course, with the velocity of light.

This theory, then, is that the electron when it suffers a shock transmits its energy to the medium (whatever that may be) in which light travels, in the form of a train of waves of small section and of considerable length, traveling with the velocity of light. Naturally, many questions come to our mind; and the idea is too new for it to be possible to answer all of them at once. Some of them can be dealt with experimentally, some mathematically, some will have to wait for new facts and new methods of attack. As soon as the photographic measurements can be made, it will be possible to determine whether the darts of X-rays, for instance, give the same results for their average diameter as darts of visible light. This will settle the question as to whether the darts vary in diameter with the frequency. The problems presented by interference and diffraction can be dealt with mathematically. All that we can say at present is that it is not impossible that these phenomena may be explained on the hypothesis that light consists of these separate trains containing many waves of light. The method by which an electron emits a light-dart and the relation between its energy and the frequency of the radiation emitted will require very much more work. A guess is that possibly the law of emission is that the radiation is emitted for a definite time whatever the energy to be communicated, and that consequently the frequency has to be proportional to the energy in order that different amounts of energy may be radiated in the same time. Since the amount of energy in a light-dart is very small, light of ordinary intensities contains enormous quantities of them, and it is only in a few cases that any distinction could be detected in the effects produced upon matter between a continuous radiation of energy in the form of waves as demanded by the older theory and a rain of projectiles such as is now suggested. A rain of arrows, for instance, if sufficiently closely packed would have just the same effect upon a material as hitting it with something solid; and in the same way we should expect that the classical wave theory would hold except where we might have methods of exposing individual particles to radiation and observing what happened to them.

This theory is, of course, quite new, and there are many difficulties which it will have to meet, but if we had no classical wave theory of light and were considering only the facts known to us, it is not impossible that the difficulties presented to the ordinary wave theory by the photo-electric effect, the absorption of X-rays, and the theory of photographic exposure would appear less formidable than those which the problems of interference and diffraction present to the light-dart theory. Fortunately, the theory leads to a great many experiments, and it will probably be possible to come to definite conclusions as to its value as soon as the many experiments which are indicated can be carried out.

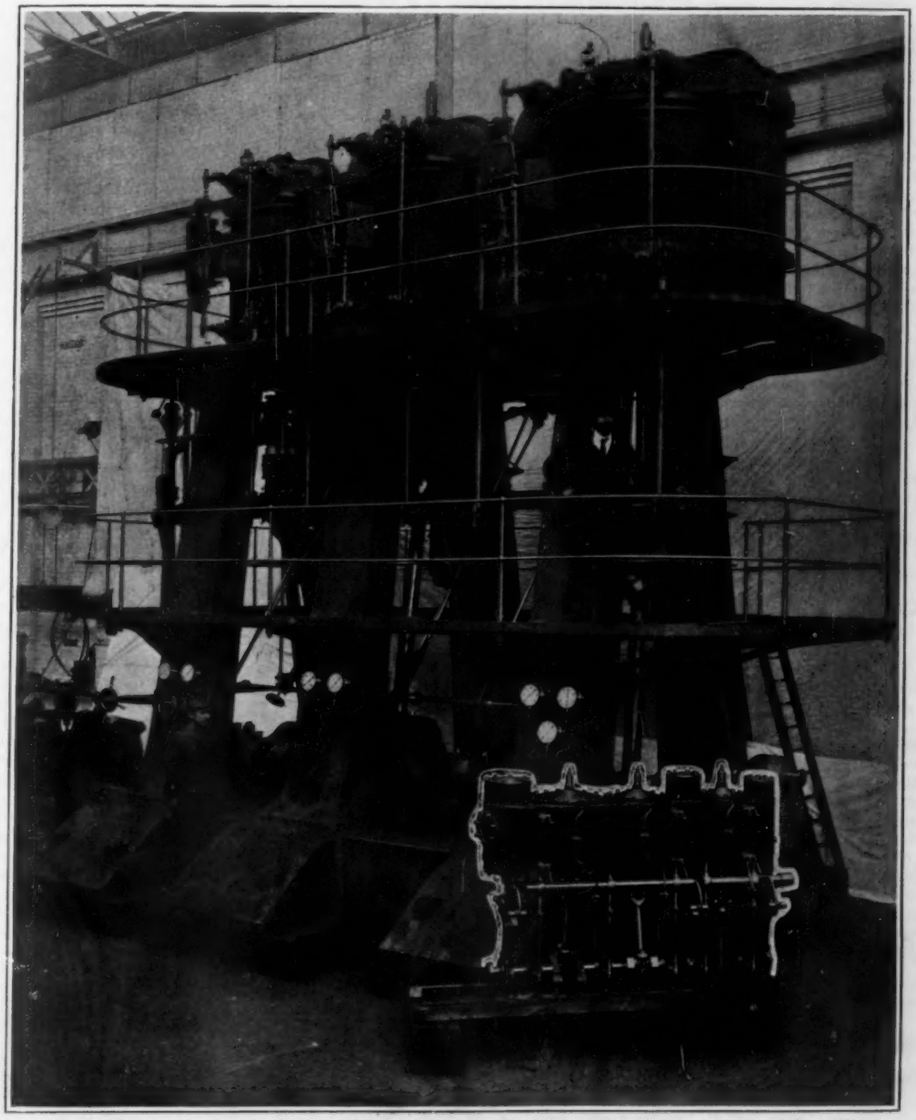
Speed as a Factor of Horsepower

IF one were asked to name the element in a steam engine which has contributed more than any other to its increase in power and efficiency, he would not be far wrong if he named that of speed—speed of revolution. The early steam engines, such, for instance, as the great, single-cylinder pumping engines of over 100 years ago, were very slow-moving machines. So were the early stationary engines. Steam pressures were low, running from, say, 10 to 25 pounds to the square inch, and to secure the desired total pressure on the piston it was necessary to make its diameter inordinately large. But in spite of the large piston area, the total thrust of the crank pin was moderate; and in order to get a large turning movement, the crank pin had to be made of great length; hence, cylinder diameters were measured in feet, and would run up to as much as seven feet. The stroke was in proportion. Even as late as the middle of the nineteenth century we find the Great Eastern with oscillating paddle engines, whose cylinders were over 6 feet in diameter by 14 feet stroke, while the cylinders of her propeller engines were no less than 7 feet in diameter.

As the art of engine building progressed, and the manufacturer was able to supply better qualities of steel, engineers began to aim at getting power more through the speed of the engine than through its large dimensions. This development progressed until power users were able to secure small, compact steam engines, occupying merely a fraction of the space, and weight, to say nothing of the cost, of the heavy and cumbersome engines of the same horsepower output.

The conditions confronting the naval engineer, under which it was desirable to keep the whole of the motive power below the protective deck—and therefore below the waterline—proved to be a great stimulus to engineers in their effort to cut down the bulk and weight of modern engines, and it was here that great progress was made; cylinder diameters being reduced, steam pressures increased, and the speed of revolution raised.

This was notably the case when the torpedo boat, with its demand for a combination of small size and high speed, made its appearance, and it was in the torpedo boat destroyers that the high speed, high power, steam engine reached the peak of its performance. In these little engines the very finest materials and workmanship were incorporated, and the speed of revolution run up to several hundreds per minute. The striking photograph which is herewith shown represents, in telling fashion, the effect of high speed in reducing dimensions. Both of these engines were built in the shops of the Yarrow Company. The larger of them, a slow-speed pumping engine, is 21 feet 9 inches in length by 14 feet 8 inches in breadth, and 22 feet 10 inches in height; the other, a high-speed destroyer engine, is 6 feet 9 inches in length by 2 feet 6 inches in breadth, and 4 feet 9 inches in height. The total horsepower of these two engines, in spite of the great difference in dimensions, is the same.



The pumping engine measures 21′ 9″ x 14′ 8″ x 22′ 10″ in height. The torpedo-boat engine is 6′ 9″ x 2′ 6″ x 4′ 9″

The massive slow-moving pumping engine and the diminutive torpedo-boat engine are of the same horsepower

Modern Stone Age Men

OVER a vast region in the arid interior of Australia the inhabitants are still in the age of stone. And an effort is being made to keep them there. Through the joint action of the Commonwealth (as the owner of the Northern Territory) and of the States of West Australia and South Australia an area of 65,000 square miles has been set apart as a sanctuary for the native fauna (including the genus homo) and flora. This reserve is the largest of its kind in the world. It has an area almost equal to that of the State of Missouri (69,415 square miles) or of Washington (69,180 square miles). Much of it is practically unexplored. The very few exploring parties which have entered it have usually traversed it in haste, owing to the difficulties in obtaining water and to fears of the attack by the natives.

Many of the aborigines in this region have never seen a white man. They still fashion their rude weapons and implements of wood and stone, and are entirely ignorant of the use of metal. Of their numbers little is known, but it is estimated that they do not amount to more than 2000 or so. At Charlotte Waters, the nearest point at which records have been kept, the rainfall averages only 3½ inches a year.

Cannibalism is still in full force among the wild natives of the Everard Ranges. In order to obtain food the aborigines have to be constantly on the march. When the old folk can no longer keep up with the tribe, men secretly told off for the purpose creep up behind them and knock them on the head. In order to avoid waste they are then cooked and eaten.

Captain S. A. White, one of the very few white men who have ever entered the reserve, found that while the natives knew nothing of the art of smoking, they were much given to chewing the leaves of an indigenous species of tobacco which grows wild in the Everard Ranges. This is a new species, somewhat closely related to the tobacco of commerce, and has been given the name of nicotiana suaveolens excelsior.

It is proposed to allow the natives within the reserved area to go on living in the Stone Age. No white men except a few specially guaranteed scientists are to be allowed to enter the sanctuary. In particular no missionaries are to be let pass within the pale.

Over most of the rest of Australia the aborigines have vanished or are steadily disappearing. The Tasmanian race, a distinct variety of man, has been extinct for 45 years. In Victoria (90,000 square miles) there remain about 500 "natives," of whom, however, only a dozen or so are of pure blood. In New South Wales (325,000 square miles) there are fewer than 4000, including half-castes. Over the greater part of South Australia, Queensland, Western Australia and the Northern Territory the aborigines are steadily melting away.

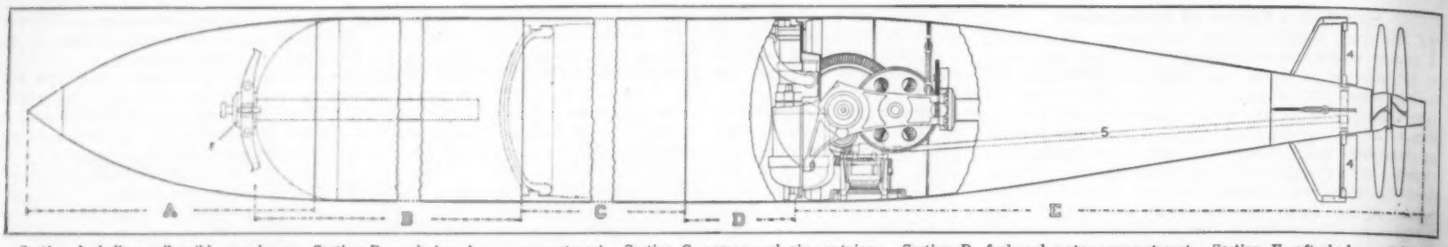
It is hoped that in this reserve in the far interior a remnant of the race may be preserved untouched and uninfluenced by the white man's civilization.

Effective Methods of Liming

TO be effective, lime should be as thoroughly mixed as possible with the plowed portion of the soil. This is usually most economically done by broadcasting lime on newly plowed land and mixing it with the soil by the disking and harrowing necessary to prepare the seed bed. Most of us advise against plowing lime down. In theory, a portion of the lime application might be made before plowing and disked into the soil and the remainder applied after plowing as above suggested. There is no evidence, however, showing that this would be economical. The time of application or the season of the year is immaterial, and in farm practice it will often be determined by the distribution of farm labor. The place in the crop rotation should be just preceding the crop most responsive to lime, providing it is convenient to apply at that time and the preparation of the land will provide for proper mixing of the lime with the soil. Where this is not possible, it may be applied for a crop earlier in the crop rotation.

While top dressing with lime is not generally advised, it may be justified on land already seeded to clover, especially when the success of the clover will be largely determined by the lime. For top dressing, finely pulverized limestone may be better than freshly burned lime in spite of frequent statements to the contrary. Freshly burned lime used as a top dressing is subject to puddling, in which case the lime will cake and remain on the surface for a long time after being deposited.

The old method of spreading lime from small piles distributed over the field by means of shovels is not to be recommended. Such distribution is too uneven to expect the best returns from it. Nothing is better for spreading lime than a lime spreader made for the purpose. One which will provide for a wide range in the rate of application, will not clog, and will spread uniformly is to be recommended. The lime should be so placed in the field that it will be accessible to the lime spreader and provide for the minimum amount of handling of the lime.—*Abstract from the article by F. D. Gardner in the Journal of the American Society of Agronomy for May, 1921.*



Section A, hollow collapsible speed cap. Section B, explosive charge compartment. Section C, compressed air container. Section D, fuel and water compartment. Section E, afterbody containing 500 h.p. gyroturbine power plant, as shown in section broken away, and the hydrostatic mechanism for controlling the depth of navigation

Fig. I. New 21-inch gyroturbine with radius of 5000 yards at 50 knots

A Fifty-Knot Torpedo

AN ingenious application of the gyroscopic method for steering torpedoes invented about 1884 by Captain John A. Howell, an American naval officer, has recently been introduced in a high-powered turbine-driven airplane torpedo designed by Mr. H. W. Shonnard of Montclair, N. J., who for several years was associated with the development of the well-known Bliss-Leavitt torpedo, now the standard weapon of its kind of the American Navy.

Until Howell proposed the utilization of the gyroscopic force created by a spinning mass, and adapted such to practice by constructing a small torpedo fitted with a heavy fly-wheel having its axis in the horizontal plane athwartship, which fly-wheel when spun to a high rate of speed served the double purpose of furnishing gyroscopic force and also energy for propulsion, no reliable self-controlling means for steering torpedoes had been developed.

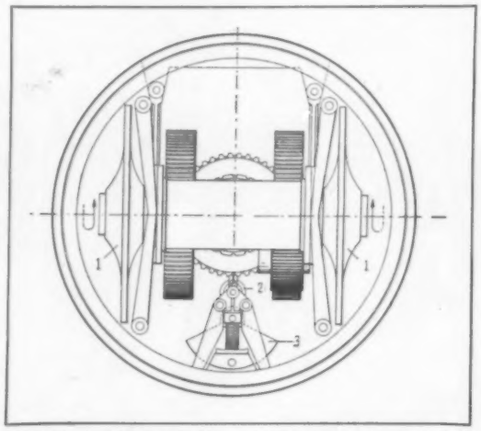
Under the plan devised by Howell, a lateral extraneous force that might tend to deflect the torpedo from its course, would cause the torpedo, through the gyroscopic action of the rotating fly-wheel, to roll slightly to port or starboard, according to the direction of said force, and bring into action a pendulum-controlled ratchet mechanism which operated a pair of vertical rudders. This means of steering was very effective and reliable. About 1888 the Whitehead Torpedo Works succeeded in applying a gyroscopic principle for steering in the form of a miniature removable unit, known, after its inventor, as the Obry steering gear. This device gave such control.

Throughout the subsequent evolution of the torpedo the excellent principle evolved by Howell has for many years apparently escaped the attention of inventors and engineers.

In the Howell method the elemental basis of control originates in the gyroscopic force of the torpedo's motive means, which, it will be remembered, was a heavy fly-wheel in which necessity for delicate adjustment of the mechanism is eliminated, since any tendency of the torpedo to leave its course as a result of extraneous influence is automatically suppressed. On the other hand, in mechanism of the Obry type no automatic suppression or correction of gyroscopic precession is possible, the course of the torpedo being entirely dependent upon a miniature, delicately-mounted gyro-wheel remaining in the plane of rotation established at the time of launching the torpedo. Should it precess, and it usually does, and often to a considerable extent, proportionate deflection in the torpedo's course results.

Continual advancement in the speed and range of torpedoes and the height from which it becomes desirable to launch them, now that the airplane is available for the purpose, calls for gyroscopic mechanism of a rugged nature that is capable of continuous and closer control than is characteristic of Obry gear. The solution of these requirements is to be found in the method of Howell, and the designer has accordingly applied the same to his turbine-driven torpedo in the manner illustrated.

In Fig. 1 is shown the general arrangement of the Shonnard 50-knot airplane torpedo, wherein turbine rotors create the gyroscopic force necessary for steering under the Howell system. By referring to Fig. 2, which is a view of the turbine compartment looking aft, it will be noted that the two turbine rotors 1, 1, of the DeLaval type, which are geared to revolve at 22,000 revolutions per minute in like direction as is indicated by arrows, are mounted upon horizontal axes, one each side of the major, or longitudinal, axis of the torpedo, and a servo-motor, or air engine 2, controlled by a pendulum 3, is located below the turbine. This pendulum unit which is connected with the vertical rudders 4, 4, by the rod 5, Fig. 1, operates said rudders in response to the gyroscopic action of the turbine rotors, exactly as the pendulum arrangement of Howell operated rudders in response to the gyroscopic action of a fly-wheel.



1, 1, The two 250 h.p. turbines. 2, The servo-motor, controlled by 3, the pendulum, to regulate the depth of the torpedo

Fig. II. Cross section at the gyroturbine power plant

The motive energy used to operate the turbines is superheated steam in combination with the products of combustion of alcohol burned in compressed air; which mixture enters the turbine nozzles at a pressure of 500 pounds per square inch and at a temperature of 1500 degrees Fahrenheit.

In combining the steering and motive elements in a single unit, a further advantage is secured in the saving of weight due to the elimination of the Obry gear mechanism, which effects sufficient change in moment to permit of the installation of a power plant capable of developing 500 horsepower without disturbing the normal horizontal trim of the torpedo. In view of the probable limitation of warship construction, Mr. Shonnard's proposal becomes of particular interest, since it presages a notable advance in airplane torpedoing for coast defense.

Measurement of Leather Skins

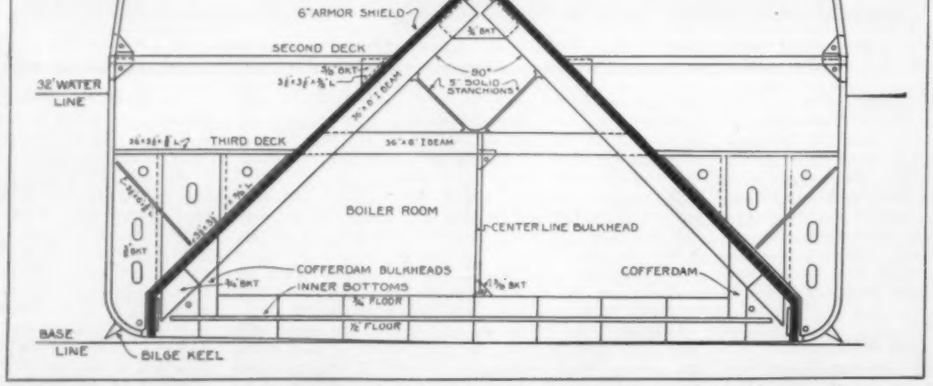
SKINS from which leather of various kinds is made are purchased on the basis of area, and the method used in determining this area has been the subject of careful investigation in the past by the Bureau of Standards. Recently a rather interesting case came up in which the Bureau was called upon to act as an umpire to decide whether certain skins were correctly measured. Some American dealers submitted 48 glazed kid skins of which 24 were said to be of domestic origin and 24 from foreign sources. The dealers believed that there was an inconsistency in the measurements of the foreign skins as compared with the domestic. After determining the areas with great care, the conclusion reached by the Bureau was that the domestic skins were over-measured approximately 1½ per cent, a comparatively insignificant amount, while the imported skins were found to be overmeasured between 9 and 10 per cent. An error as large as this is regarded as important; and as the skins are paid for on the basis of area, it means that too much is being paid for the foreign skins. If the samples submitted were representative of the conditions existing in the trade, the whole matter should be carefully looked into.

Internal Diagonal Armor for Warships

THE diagram accompanying this article, which shows the cross-section of a battleship, represents, by the two heavy black lines, a suggestion by one of our shipyard workers, Mr. C. H. Scheelky, for a method of armoring warships to meet attack by modern high-angle fire, by aerial bombs and by torpedoes.

In spite of its striking novelty and certain difficulties of interference with boiler and engine-room accommodations, the general idea is so much in keeping with the latest theories of warship armoring that we present it for consideration. The armor plan of ships built prior to the war calls for very heavy vertical armor, supplemented by light deck or horizontal armor. That was in the days when 10,000 yards was considered an extreme fighting range, and when shells fell upon a ship at an angle of 6 to 8 degrees. Today, the fighting will be at the extreme practical range, and the angle of fall will be from 18 to 25 degrees; which means that the greater part of the deck will be opened to direct attack. Hence the growth in favor of internal inclined armor.

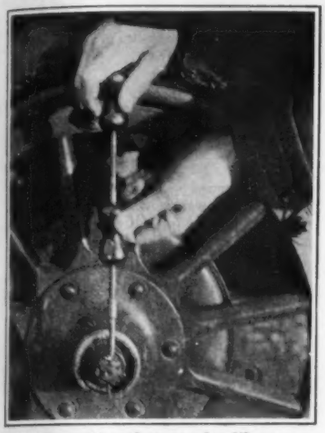
The interesting point about the proposed method is that the design shows no vertical armor, and that the inclined armor is carried right down to the bilges. In answer to our question as to why this was done, Mr. Scheelky answers that torpedo attack has become so effective and deadly that it is necessary to keep the blast of explosion out of the engine and boiler rooms if the ship is not to be disabled.



Inclined armor for protection against shells above, and against torpedoes below, the waterline

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



Cotter puller that works like an inverted hammer

Another Cotter Puller

THE cotter-pin extractor which we illustrate is different from the majority of such tools, in that it does not attempt to provide an actual leverage against the recalcitrant pin. A hook on its small end engages the loop of the cotter. Of the two handles that appear in the photograph, the upper is fixed and the lower slides. The sliding one is then moved up and down on the rod, striking sharp blows upon the under side of the fixed handle. The effect of this hammer action is to drive the cotter out of its seat. Conditions are easily imaginable under which this would be about the only tool that could deal with an inaccessible pin. It will also pull axle-shaft roller-bearings, and will straighten radiator fins and tubes.

Short Cuts for the Draftsman

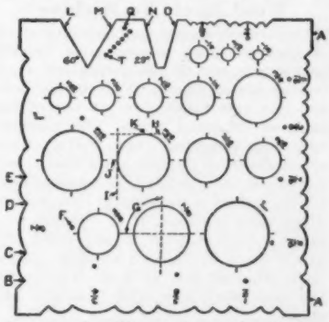
STENCILS of one sort or another for the use of the draftsman are not exactly a new story, but the pictures which we present herewith make it clear enough that this useful idea has not been by any means pushed to the point of exhaustion. The apparatus which appears in the diagram of our second column is a sort of general utility tool. It is accompanied by a little circular that gives complete instructions for the drawing, with its aid, of circumferences from ⅛ to 9 1/16 inches; U. S. standard screw nuts from 3/16 to 1 inch; screw threads of 60-degree angle and acme threads of 29-degree angle; lettering of 14½ and of 30 degrees inclination. Its very general utility contrasts interestingly with the very special field which is covered by the stencil that appears in our first column. This is designed to aid the draftsman who is called upon to produce a large number of chemical drawings, with their conventional representations of the various laboratory apparatus. It seems clear enough that he would not have to do much work of this sort to save the price of the instrument. Who will now put out a similar tool for the standard circuits and other symbols of electrical drafting?

Stencil for the draftsman who is working in chemistry

Clever Automatic Chain-Welding Machine

A CLEVER machine for automatically welding chain is described in the *Berliner Tageblatt*. Compared with flame and autogenous welding, electric welding has the great advantage of making an entirely homogeneous joint, because dirt and oxidation have no effect, and also because any uncertainty connected with handwork is avoided.

These advantages are particularly noticeable with special machines, such as the automatic chain-welding machine of the Wenniger Works in Munich. It has taken several years to develop this machine, as there were many difficulties to be overcome. The greatest difficulty was the designing of suitable mechanism for altering the velocity of travel of the chain for varying thicknesses of wire to be welded. The chain is fed in through guide-rails, and is moved forward by means of clamps in such a way that a joint always lies under the electrodes of the transformer. The primary current is switched on, and the secondary heats up the ends to welding heat in a very few seconds. At the same time the link is gripped from both sides and the ends lightly pressed together, so that the diameter at the joint is increased. This pressure cuts off the current and sets in motion the mechanism for pushing the chain forward. The chain is moved forward one link, and the joint of the link just welded is smoothed down. About ten links are welded per minute.



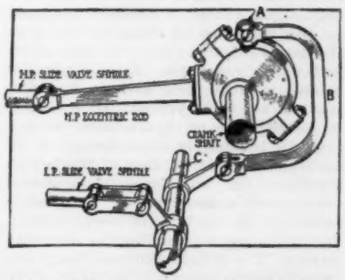
A general utility tool for the draftsman that saves much time

New Air Purifier

A SANITARY novelty has been placed on the market recently that purifies the air wherever it is placed. Within the enameled, perforated box a block of specially treated paraffine is placed. The perforated section slides off, permitting new blocks to be placed inside as evaporation takes place. One block will last four weeks, but must not be placed in any direct draft.

A British Steam Truck

DESCRIPTION of a steam truck of British manufacture unusual in some respects, has recently appeared in *Motor Transport*. The boiler is of a type which has about double the heating surface usual in steam wagons. It is of a type, too, in which the smokebox doors at each end are utilized as chambers for the exhaust steam, which, thence, through small nozzles, escapes along the upper tubes of the central combustion chamber at the base of the chimney. In the present design each smokebox door has six exhaust nozzles discharging through a single row of large tubes. Incidentally, each exhaust pipe is formed with a trap for condensation. By disposing of the exhaust steam on this method, it is obvious that a steadier and gentler draught is possible; consequently, the type affords an easy steamer, requires little or no forcing, pulls its fire about but little; while in no other is the water level less affected on steep gradients; the fusible plug can be fixed 8 inches to 9 inches below the water line, and so the risk of ruining one is very remote.



Arrangement of high and low pressure units in new steam truck

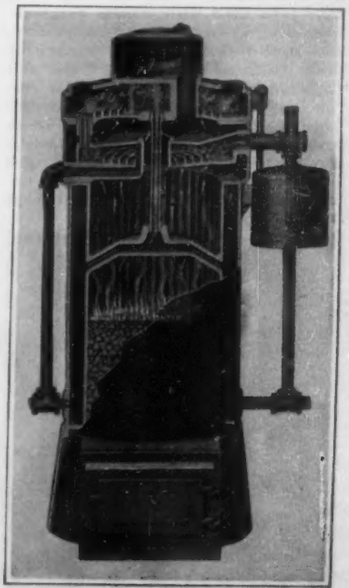
The engine motion is such that the D slide-valves of both high- and low-pressure cylinders in both forward and reverse directions are operated off a single eccentric. The principle of this motion is as follows: The cranks of the two cylinders are at right angles to each other. The eccentric works the high-pressure valve direct and at a point 90 degrees further round (to correspond with the position of the low-pressure crank), the eccentric strap carries a lug A, whence a link B transmits this motion to a rocker shaft C, off which the low-pressure valve is actuated. The whole arrangement is best seen in the sketch on this page. Incidentally, this is the only undertype steam wagon employing a compound engine.

Steam in Four Minutes

RECENT developments in steam generation include application of the principle used in the well-known coffee percolator, where a small quantity of water is heated at one time. Externally the new boiler has an appearance similar to the ordinary house-heating boiler, but the interior construction is quite different. Immediately above the fire, which may be wood, coal, gas, oil or any form of fuel, is located a cast-iron spider which contains less than a gallon of water. This spider is fed with water from the water jacket through six cast-iron legs. The water supply instead of being contained in the boiler immediately above the fire as in other boilers, is contained in an equalizing water column at the side of the boiler, and feeds from this water column into the water jacket and then into the spider as it is needed to replenish the water taken out of the spider and converted into steam.

Handy air purifier that hangs on the wall

Water entering the heater travels upward from the bottom through the water jacket, absorbing heat as it does so, and flows through the hollow arms to the center of the spider, which is located in the hottest part of the combustion chamber. At this point the water is partially converted into steam, the expansion shoots water and steam up through the vertical geyser-tube into the top steam-chamber, where it is immediately converted into steam. A series of concentric upward projections keeps the water distributed in a thin film over the heating surfaces. Water not evaporated in this top steam-chamber flows through nipples on to the bottom plate of the lower steam-chamber. This plate is also part



House-heating boiler that works like a coffee percolator

The illuminated glove for traffic signalling

of the heating surface, and is provided with upward projections which distribute the water uniformly. Any water still unevaporated here flows through a cored passage and downward through piping into the general circulation.

The whole apparatus consists of simple castings and pipe fittings so put together that complete or partial disassembling for access to any interior part takes but little time.

Laboratory tests taken at the Carnegie Laboratory at Stevens Institute give the boiler an efficiency rating of 75.89 per cent, which is about double the efficiency of the ordinary house-heating boiler. In this test, the time from the lighting of the fire to one pound pressure by the gage was four minutes, and to nine pounds pressure was seven minutes. The temperature of the water in the boiler at the start was 73 degrees Fahrenheit at the bottom. At the end of seven minutes with nine pounds pressure of steam by the gage, the temperature of the water in the boiler at its base had reached only 80 degrees. This shows that steam is generated practically from the time that the fire is lighted, and without the necessity of heating the entire body of water to the temperature of the steam.

Conveyor Belts of Steel

WHEN we in this country think of conveyor belts we naturally picture to ourselves one of leather, rubber or some specially prepared fabric, for we have been accustomed to seeing and using belts of this description. Abroad, however, flexible steel conveying belts have been used with success for some time. They are made from Swedish charcoal steel with a carbon percentage of about 0.65, cold rolled, hardened and tempered by a special process by a certain steel works at Sandviken, Sweden. This works has a controlling interest in a very large number of the world famous Swedish mines that produce iron ores low in sulfur and phosphorous.

The steel belt conveyor is said to be especially suited to conveying warm, sticky, sharp or abrasive material which rubber and fabric belts do not handle with satisfaction. It is also said to be lower in maintenance cost than apron conveyors and wire woven belts, to consume less power, and to eliminate spilling. In the sugar, pulp and lumber industries all over Scandinavia where these steel belts have been in extensive use, they are running in the open air subjected to rain, snow and sunshine and are said to work exceptionally well. A coating of rust appears, when the belt is idle, but a thin film forms that protects the steel from further injury, and the rust itself does not penetrate.

The police "tear bomb"

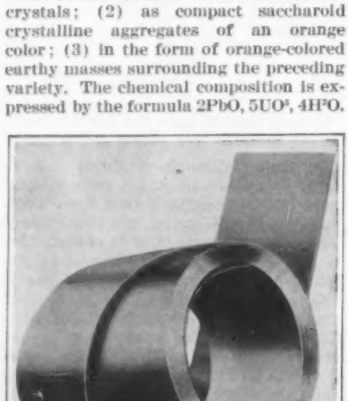
Glove with Signal Light

ON the back of this slip-over glove for motorists is a flashlight operated by a small storage battery seen in the case. By pressing button with thumb a driver can give a red flashlight signal when using his hand for signaling. It is used at night only. Made to fit either hand.

A New Radioactive Mineral

AT a meeting of the French Academy which took place December 5th, 1921, a report was read by M. Alfred Schoep describing a new mineral from the Belgian Congo, to which he proposes to give the name of *Curite* in honor of the late Professor Curie, because of its radioactive character. This mineral is soluble in nitric acid even in the cold, the solution being yellow. It is readily dissolved by warm hydrochloric acid.

Curite is found in three forms: 1. As translucent reddish brown needle-like crystals; (2) as compact saccharoid crystalline aggregates of an orange color; (3) in the form of orange-colored earthy masses surrounding the preceding variety. The chemical composition is expressed by the formula $2PbO, 5UO^3, 4H^2O$.



This 24-inch roll contains 285 feet of flexible steel belting

The Police Tear-Bomb

MUCH has appeared in the daily press about the use by our police of tear bombs in the effort to control the outbreak of crimes of violence from which we are right now suffering. The illustration herewith shows how one of these bombs works, and will strike a familiar chord in the minds of those who went through actual service in the war. When the pin between the upper and lower sections of this queer bottle is pulled out, the liquid in the small tube above will flow at the slightest shock out of this tube and into the bell-shaped body below. This shock of course comes with the throwing or in any event with the striking of the bomb; and a reaction is at once set up which releases a large volume of a gas that makes the immediate neighborhood highly uncomfortable for human habitation, while doing no slightest permanent harm to its victims. This particular version of the gas bomb is the invention of Major S. J. Delanoy of Trenton, N. J.

The Expansion of Metals

SSIENTIFIC Papers of the Bureau of Standards, No. 426, entitled, "Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel, and Aluminum," gives data on the thermal expansion of 29 samples of commercial nickel, monel metal, stellite, stainless steel, and aluminum, and results obtained by previous observers on the expansion of nickel and aluminum. The results are presented in the form of tables and curves. For example, the expansion curves of stellite show irregularities in the region between 300 and 500° C. However, for commercial nickel only a slight irregularity was perceptible at about 350° C. For the range from room temperature to 100° C., the coefficients of expansion vary from .0000096 for a sample of hardened stainless steel to .0000239 for a sample of exceptionally pure aluminum. This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to the Bureau.

The disking saw that makes joints in wooden members

Wood Joints by Machine

THE roughing out and finishing of an accurate joint between two wooden members is one of the carpenter's most tedious tasks. One E. W. Hobbs of London has now taken this job out of the category of hand work. The machine which we illustrate consists of a clever arrangement of circular saws which slots the pieces to be jointed, and makes keys for these slots in the form of thin wooden disks. The machine, it is claimed, will make a perfect joint in any wood and at any angle in eighteen seconds, against an average of half an hour or more for the same work done with hand-saw and chisel.

A New Autographic Camera Attachment

AUTOGRAPHIC cameras have been in use long enough for their advantages to have become thoroughly familiar to all. Mr. W. A. Brown, of Rochester, N. Y., dissatisfied with the way in which his machine worked, however, decided that while the autographic feature was fine on general principles he could improve upon the usual means of achieving the result. We illustrate his new apparatus, on which a patent has recently been issued to him.

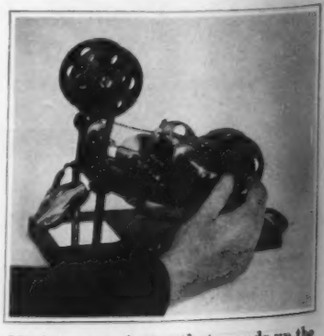
Mr. Brown's idea involves writing directly on the film, instead of through a piece of light-proof paper; and it makes it possible also for the writer to see better what he is writing. He employs an adaptation of the familiar pantograph principle. The operator writes with an ordinary pencil on an ordinary pad of paper attached to the outside of the camera; and the text is reproduced by a second pencil, inside the camera, driven by the one held in the hand. The two pencils are connected by a sliding rod that pierces the side of the camera via a light-proof sliding shutter. Pressure on the outside pencil rocks the inside one up against the surface of the film. When the outside pencil is swung around and laid away in its socket, the inner pencil is similarly rocked around and laid down at the side of the box, out of the range of the exposure. Spring pressure on the inside pencil takes care of any lack of uniformity between the surfaces of pad and film.

The camera with the back removed to show how the outside pencil drives the inner one

For the Film Editor

INSPECTION of motion-picture films in the process of editing a play, etc., is a rather time-consuming task. The director or editor has to leave his desk and journey to the projecting room, and he has to communicate his desires for stops, starts and re-runs to the operator, who may or may not get them the first time. A clever little apparatus has just been put out by M. Charcot, a well-known French theatrical man, which greatly simplifies this work of inspection, especially of short strips of film.

The reel with the intermittent control is the usual one of the cinema world, so that the film is run off in the ordinary fashion so far as this is concerned. It is viewed in anything but ordinary fashion, however. Light from above passes through the strip and strikes the mirror which is seen, mounted flat, on the baseboard under the apparatus. From this mirror the rays are reflected through the magnifying lens which stands at an angle to the mirror. The person desiring to inspect the reel merely puts it on the spool, threads it through in the usual fashion, and starts to grind it out by means of the little hand crank shown. The reel passes between the light-source and the mirror at the usual speed of 16 frames per second, and the operator, adjusting the lens to the correct angle, looks through it and sees the magnified pictures flit across his visual field in the mirror. That is all there is to it. He can stop, start, reverse, repeat, etc., at his own pleasure and without misunderstanding; and he can view a short strip of a few feet just as easily as a full reel.



Miniature projector that speeds up the examination of film in the cinema studio

The Alula wing, of small span and bird-like appearance, which is claimed greatly to economize power

Airplane Wing of Bird-Like Lines

RECENTLY there was demonstrated at the Northolt airdome in Great Britain a novel wing design of interest. This wing, which is known as the Alula, strikingly resembles that of a huge bird, arched at the center and tapering away to a point at the tips. In a practical test against a Bristol fighting plane of approximately the same horsepower, the machine equipped with the new wing attained an elevation of three thousand feet in 72 seconds, leaving the other plane far behind. Although in no sense a racing type, this test plane developed a speed of 180 miles per hour. The new wing, which is designed by Alexander Holle, is applicable to any style of plane.

A Screw-Lock for Doors

A NEW type of door lock has made its appearance. Instead of projecting a square or oblong bolt into the keeper, this lock screws the door securely to the door frame. A threaded, cylindrical bolt, by a turn of the key, is propelled longitudinally so that the threads of the bolt mesh with the internal threads of the keeper on the same principle that one would screw together two pieces of metal. The advantage of such a bolt is obvious, and the lock is rendered impregnable against the attacks of the most powerful "jimmy."

An important, and heretofore unknown feature in locks, a most simple and ingenious device, manually operated from the inside, instantly disconnects the lock mechanism from the key-operated cylinder on the outside. This makes the lock absolutely nonpickable against the finest of instruments, even the key itself.

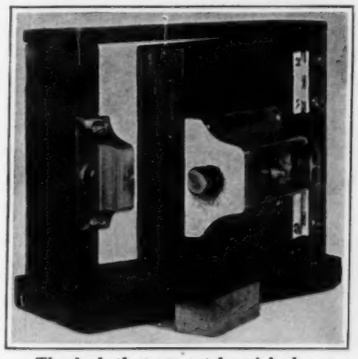
The entire mechanism is simple and durable, the absence of dogs, tumblers or operating springs making it impossible to get out of order. It is, at once, non-jimmiable, non-pickable and the most powerful door lock devised.

An effective tool for raising a car to work beneath it

An Improved Washboard

AN inventor has taken the rub out of the old washboard, and his new design makes use of wooden beads used as rollers to force soap and water through the material being cleansed.

The notion that rubbing clothes removed the dirt seems to have been an old idea handed down from the ages. As a matter of fact, the rubbing simply forced the soap and water through as does this new principle washboard, but it took the material with it quite frequently.



The lock that cannot be picked or jimmied

A Substitute for the Jack and the Crawler

WHERE the entire internal mechanism of an automobile must be dismantled, the problem of working beneath the car does not arise—dismantling, save for the trifling matter of the removal of a few bolts, etc., proceeds from above. For minor repairs such as the removal and replacement of a connecting rod, the slight amount of work that has to be done beneath the car does not warrant any such expenditure of time as is necessary to put the car on one of the large capsizing cradles which we have illustrated from time to time in the past. Nevertheless, if some means of avoiding the necessity of crawling under the car and working in a cramped position were available, convenience and economy would be served.

The use of garage pits is one way out. Consensus of opinion, however, stamps this as bad practice. Both the carbon monoxide from exhaust and the explosive gasoline vapors which make smoking taboo in the well-conducted garage are heavier than air; and without going to inordinate expense for ventilation of questionable effectiveness, the danger of a man working in such a pit being asphyxiated or blowing the shop up with the spark from a poorly connected light extension is so great that in some cities garage pits are absolutely prohibited.

A rather attractive effort to solve the problem comes from France. A stout steel bar is run through the ends of the springs, fore or aft. This bar is straddled by a high four-legged stand, through the top of which is threaded a long vertical screw member. The bottom of this member carries a hook which engages the bar first mentioned. When the screw is turned up, the whole apparatus acts as a screw jack, of unusual power and amplitude. The latter feature is so pronounced, in fact, that the car can be lifted no less than 28 inches at either end. This makes it possible to raise it to the most advantageous height to enable the work in hand to be done from a sitting or a standing posture, at the mechanic's option. In the bargain, for all such operations as testing wheels, axles, running gear, etc.; for jacking up both wheels simultaneously for changing tires, mounting chains, etc.; this device appeals to one as altogether superior.

A Solar Stove of Tin Plate

COAL and water-power have one thing in common; when we use them, we are taking advantage of nature's long, roundabout processes for storing up the power that exists in the sun's rays and making it available for our purposes. We are not content to depend upon her storehouses, however; the problem of direct utilization of the energy latent in sunlight is one to which our inventors are continually turning their thoughts. Installations described in the SCIENTIFIC AMERICAN several years ago for the purpose of heating water for household use interested Mr. W. S. Gripenberg, of Masaby, Finland, to such a degree that in spite of the rather unfavorable climate of Finland for this sort of thing he commenced a series of experiments. A cooking apparatus which he has completed and installed is functioning to his entire satisfaction, and he supplies a drawing to show how it works.

Mr. Gripenberg took it for granted that for actual cooking more than mere exposure to the sun was necessary—some sort of collecting apparatus for the rays, he believed, would be essential. And he made the rather surprising discovery that ordinary tin plate was in every way suited to this use. He points out that we must not confuse the requirements of heating with those of optics. Whereas all the rays emitted must be brought by an optical mirror to a focus within an area at most 0.004 inch square, this area in the case of heating a fairly large utensil becomes 5x5 inches—the area in the latter case being 1,500,000 times as great as in the former.

The rubless washboard

Home-made sun-cooker that gives good service in the high latitudes of Finland

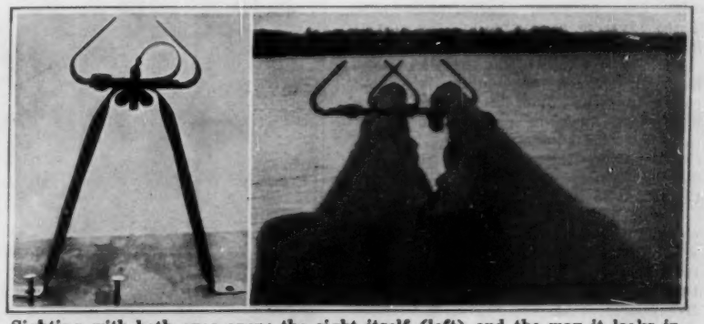
The construction, by ordinary means, of a spherical mirror of tin plate is of course out of the question. But again Mr. Gripenberg took advantage of the fact that the requirements of heating are rather rough. He made seven strips of tin, each three feet long and six inches wide, and bent each into the form of a circular arc of five feet radius. He then brought these pieces together in a wooden frame so that they formed roughly a spherical mirror of five-foot radius and 2½-foot focus. To some extent his strips overlap, and to some extent they gape; but the mirror serves none the less admirably. It is necessary to readjust it about once each half hour, to compensate for the sun's shift of direction.

Mr. Gripenberg points out that in Masaby he has no experience with a sun higher than 53 degrees. As low as ten degrees he finds serviceable on a clear day.

The Both-Eyes-Open Sight

"UNHAPPILY this entails optical impossibilities," wrote E. C. Crossman, then plain Mr., since become Capt., in discussing the conventional methods of rifle sighting in the SCIENTIFIC AMERICAN of December 15, 1915; "and a compromise, more or less satisfactory, has to be used with the open sight. The mark, the front sight and the rear sight lie in three different planes, and the eye can see no two of them sharply at the same time."

Eli E. Gregory, of Lewisport, Ky.,



Sighting with both eyes open: the sight itself (left) and the way it looks in action, with the crossing point of the two images lined on the target

holds basic patents on a scheme for avoiding all the troubles which Capt. Crossman here suggests—avoiding them by nothing less revolutionary than the use of two eyes in aiming! Does it not seem strange that the binocular principle—the very thing that alone makes the world about us possess depth in our sight instead of looking like a picture on a sheet of paper, the very means by which we judge distances and relative positions—does it not seem peculiar that we should always have stuck so religiously to a system of aiming a gun that demands that we shut one eye and abandon this powerful method of seeing in favor of one fundamentally weaker? To Mr. Gregory, at least, it did; and he has apparently succeeded in removing the necessity for behaving in so unnatural a fashion.

The new sight consists of an outline approximating an isosceles trapezoid, gained by setting, edge on to the shooter, a bent piece of sheet metal, beaded to prevent light reflection. Our photograph shows one shape that is available; there are numerous others that will equally serve. The principle of operation is a familiar one. Everybody knows that if he holds up a finger and looks past it with both eyes, he sees it twice—once with each eye. In the same way, if this sight is held before the eyes, properly mounted on the gun barrel, it will be seen twice—once with each eye. If the shooter will then merely keep both eyes open and shift the gun sideways until the point at which the two images of the sight cross is directly on his target, he will have the lateral range of the object, obviously. If at the same time the horns of the sight are properly shaped with reference to the muzzle velocity of the gun, rifle, etc., so that the barrel has to be elevated to bring the intersection on the target when the latter is further and further away, we get vertical ranging, too. This latter problem has to be solved separately and in advance for every muzzle velocity—the other solves itself in every case. And in every case we have instant aiming with both eyes open.

Portable Crane for Quick Handling

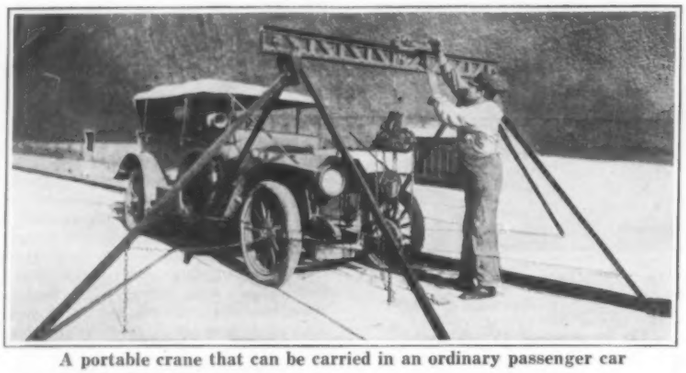
IN the handling of weighty objects, the problem to be solved consists in the lifting and handling of said objects on the very spot they are, whether in the fields or even on very irregular ground. Therefore, it is necessary to erect on the spot a portable lifting apparatus, the transportation and handling of which should be most economical.

In order to do this, it is necessary to have a device of light weight, taking up little space and easy to load and to move about in an ordinary vehicle. It is also essential that it be strong, in order to withstand shocks and bumps, and that it be simply constructed in order to permit assembling with the minimum of help.

A new system of portable lifting apparatus fulfills these conditions. It consists of two identical tripods, each of the three legs being of channel-steel with foot-pieces bolted on at the lower end, and with riveted junction plates allowing pivoting axes to pass, at the upper end. These pivoting axes are held by castellated nuts and washers and cotter pins.

At the lower half of the legs of tripods, hooks are placed for holding the chains connecting the foot-pieces. The upper bracket is made of pressed steel with three junction plates riveted at the spot through which the pivots pass. Its inner side has two gripping plates holding fast the tripod to the transverse girder.

The latter is made up of two U-shaped channel sections standing back to back, which are connected at each end by a tube holding a bolt with thumb nut. These two channel sections can therefore be easily separated. A space is left between them in order to allow the pulley hook to pass through or for placing the pulley in position directly on top of the girder.



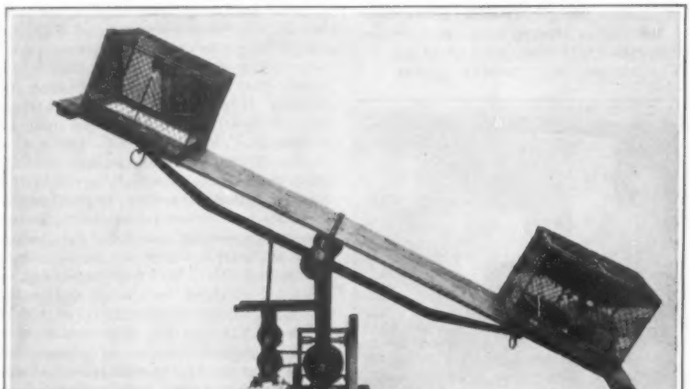
A portable crane that can be carried in an ordinary passenger car

The pulley is suspended from an axle which goes between both channel sections, but its flanges are equipped with corner-pieces which enable the pulley to rest on the girder. In the first position, it is hoisted as it is by means of a small hand windlass. In the second position, the chains and hook are taken off in order to facilitate hoisting.

Extensions can be set to the legs of the tripod. These extensions consist of channel sections with a thrust-block adjustable at various heights. The latter follows exactly the shape of the foot-piece of the leg of the tripod and two clamps are sufficient to hold the foot-piece tight against the extension.

The extensions are used, of course, to lift up the whole apparatus or else to make up for uneven ground under one or several of the legs of the tripod. In order to prevent the legs sinking in soft ground, a channel-section steel plate can be mounted at the lower end of the extension. These plates can be mounted on the foot-pieces as well as on the extensions.

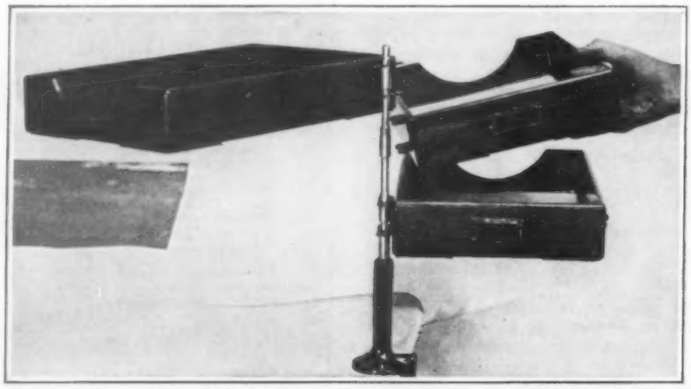
When the pulley rests on the girder, it is held tight to it by means of four plates which hold its shoulder to the upper wings of the two channel sections. The pulley can then be stopped at any spot on the girder. Only the moving equipment rises above the girder and the chains which unite it to the pulley pass on either side of the girder. The maximum lifting height is thus considerably raised.



The machine used by a French investigator of mal-de-mer to make his animal subjects seasick

Seasickness by Machine

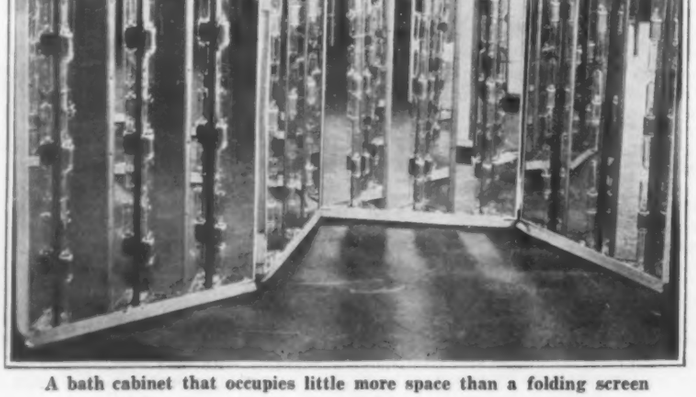
SEASICKNESS does not sound like the sort of ailment for which one might hope to find a serum. Nevertheless, Dr. Pozerski, head of the Pasteur Institute Laboratory in Paris, has been looking for a serum for it, and actually believes he has found one. Obviously, however, it has been necessary for him to test it out on cases of actual mal-de-mer; and it has not been convenient for him to embark his laboratory aboard ship in order to meet this requirement. Our photograph tells the rest of the story; if we can't use a ship, we must have a seasickness machine. The animals on which Dr. Pozerski has experimented have been ridden about in the air in the baskets on this machine, which was carefully designed by M. Jouan, a prominent French engineer, to simulate the motion of a ship's deck. Judging from the doctor's announced success in his investigations, the machine must have been a success in its field.



Correspondence trays that are always there when they are wanted, and always out of the way when they are not

Adjustable Correspondence Trays

A NEW office desk accessory which extends the capacity and utility of the desk as much as a new glazed porch adds to the service of a house, is a set of adjustable correspondence trays supported in a tier by an upright post screwed or clamped to the edge of the desk or table. Any one or all can be swung over the working surface by the stenographer, beneath her eye or hand; then moved outward, leaving the entire desk free; or removed easily and carried away. Two, three or four trays, mounted upon a grooved rod around which they revolve, make a standard set, but a larger number of units can be provided to special order. Their finish is mahogany or oak, with metal index holders. Trays can be had in both letter and cap sizes for the handling of correspondence and papers.



A bath cabinet that occupies little more space than a folding screen

A Turkish Bath Behind the Door

A FOLDING bath cabinet nearly as compressible as a screen is here illustrated. This device is equipped with lights which offer to the owner an extempore Turkish bath at home. When not in use it may be put out of the way behind a door in the crowded apartment. The lamps may be attached to the house electric light circuit. Part or all may be turned on at one time.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Gasoline from Fatty Oils

AT the present day a movement which is vitally interesting the French nation is the strenuous effort that is being made to circumvent the necessity of importing large quantities of petroleum products, especially gasoline and lubricating oils, by the location of oil fields within the country and also by developing new sources of supply of these materials from raw products produced in France or the French Colonies. An example of the intense manner in which the French are tackling this problem, which results in their considering very strange and difficult methods and processes of probably little practical importance, is exemplified in a recent communication to the Academie des Sciences. In that report it is stated that there can be produced from linseed oil and other similar oils a product which is very volatile and resembles gasoline very much in its behavior. The process involves the catalytic treatment of linseed oil with resulting elimination of water and hydrogen.

By-Products from Yellow Pine Stumps

THE United States Department of Agriculture has issued a very interesting bulletin, entitled, "The Distillation of Stumpwood and Logging of Western Yellow Pine." In this report it is stated that the stumps which are left behind after logging operations are very rich in resinous products, for which there is a ready market, as crude pine wood oils are being used considerably in the flotation process of concentrating ores. Plants which would be erected to extract these oils from the stumpwood would have to be of the single retort movable type, so that when the stumps in the immediate locality of the plant have been consumed, the latter can be dismantled and set up again at another point with very little difficulty.

Non-Fermentable Sugar Syrup

THE United States Bureau of Chemistry has evolved a process of obtaining a rich, heavy sugar syrup, which will not ferment or crystallize. This is accomplished through the use of invertase, an enzyme which is derived from yeast. One pound of the invertase enzyme is sufficient to invert 800 gallons of syrup; that is, convert cane sugar or sucrose into a mixture of grape and fruit sugar. The invertase is added during the process of making the syrup.

Waterproof Sand-Paper

ACCORDING to the "Paint, Oil and Chemical Review" of February 1, 1922, a new article has appeared on the market in the form of a waterproof sandpaper. This is especially useful in the painting of automobiles, where it can be used with water at a considerable saving of time in the place of pumice stone, in rubbing out color and color varnish coats, and also on first coats of rubbing varnish.

A Cheap Photographic Copying Process

THE paper is sensitized with a 20 per cent solution of ammonium ferri-oxalate. The copying process takes place about in the same length of time as in the use of celloidin paper. The black image is developed with a 2 per cent solution of silver nitrate, the excess iron is removed with a 1 per cent solution of oxalic acid and the picture is fixed with the aid of a 10 per cent solution of hypo. To obtain a harder print just a few grains of ammonium bichromate are added to the sensitizing solution. For further details the reader is referred to the "Photographische Rundschau," vol. 57 (1921), pp. 153-156.

New Development in the Olive Oil Industry

RECENTLY there has been developed a new process of extracting the olive oil left behind in the filter cakes in the regular refining operation. This process will very likely have a very important influence on the industry as a whole. In the former extraction process carbon disulfide was employed and the olive oil, obtained thereby and called sulfurol, possessed such a bad odor that its use was rather limited. In the new process trichlorethylene is used as the solvent, and after it is evaporated there is obtained an oil which possesses the odor of pure, refined, edible olive oil. However, this is true only when the oil, which is known as tri-olive oil, is fresh. According to "Seifenseider Zeitung," vol. 48, page 310, there does not appear to be any great technical difficulty standing in the way of rendering this oil fit for edible purposes. The tri-olive oil is not so green as the sulfurol, and, furthermore, it is more saponifiable than the latter, making it better for soap manufacture.

Sweet Potatoes as a Source of Alcohol

ACCORDING to the Journal of the Department of Agriculture of South Africa (1921), pp. 229 and 340, the sweet potato is suggested as a possible source of alcohol for fuel purposes. Compared with the ordinary potato, the sweet potato is more easily grown and contains more starch. Its composition is 72 per cent water and 25 per cent of starch and sugar, against 75 per cent water and 16 to 24 per cent starch in the ordinary potato.

Building Material from Sugar-Cane Bagasse

AT Marrero, La., there has been erected a factory for making building material from sugar-cane bagasse. The equipment of the mill is very much like that in a paper factory. The bagasse is chipped, cooked and washed, and then sent to beaters, where it is worked up until the fibers are of the proper length. A special machine converts the pulp into board and this is dried for four hours, emerging as a finished product, quite dry and hard. It is known as celotex, and can be worked just like wood, and is solid and homogeneous.

New Use for Linseed Oil

THE Chemische Fabrik Mensel & Co. of Liegnitz, Germany, has patented a process of making a rubber substitute from linseed oil. According to this process, the oil is heated for from three to four hours at a temperature of 110 to 120 degrees Centigrade at atmospheric pressure or in a vacuum in the presence of very finely divided metals, such as reduced iron, magnesium, etc. In this way a solid product is obtained which can be readily molded. Variation in the heating temperature and in the time of heating as well as in the amount of air coming in contact with the material gives products of different properties. The new material is soluble in various solvents, such as carbon bisulphide, turpentine, benzol, etc. It resists the action of acids and alkalies and is hardened by sulfur, and after the addition of anthracene, anthraquinone or steatite, it can be converted into a rubber-like mass. It can be used as an insulating material and as a substitute in making cables. It can also be used in the manufacture of linoleum, for waterproofing materials, etc.

Recovery of Potash from Wool Washing

THE Bureau of Chemistry is giving considerable attention to the development of natural sources of supply of potash. It is known that the wash liquors obtained in the washing of wool contain potash, but in the ordinary process these liquors are so dilute that it does not pay to extract the potash salts from them. The Bureau is experimenting with wool washing machines to see if it might not be possible to wash the wool in such a manner that the wash liquors recovered would contain a sufficent concentration of potash to render its recovery commercially feasible. The average fleece contains about 4 per cent of potash. There are about 600,000,000 pounds of wool scoured each year in this country, and even if only 3 per cent of the potash were recovered, this would mean the production of 18,000,000 pounds of actual potash yearly, which would be available for making fertilizers.

Tellurium Compounds Increase Efficiency of Gasoline

THERE have been so many wild reports about new motor fuels, derived from "cabbages or onions," or, indeed, from merely air itself, that are immeasurably superior to the old reliable gasoline, that the average individual, when he reads about a new invention of this order, is apt to be very skeptical not only about its commercial applicability, but about the honesty of the so-called inventor. However, there has recently appeared a note in the daily newspapers, which was afterwards elaborated in a report to the Engineering Division of the Natural Research Council, concerning a new gasoline composition, developed in the laboratories of the General Motors Corporation, which is reputed to increase the efficiency of the motor fuel by 100 per cent. While exact details are still unavailable, and while we are naturally prejudiced against these new, wonderful substitutes for gasoline, especially when they are heralded in unscientific form in the daily journals, nevertheless there appears to be an air of reliability about this report that makes it worthy of mention in these columns. It is stated that the improved gasoline composition is secured by the addition of a small amount of a tellurium compound. The automobile which was used in making the tests was equipped with a special high-compression engine. It was found that the high compression resulted in a greatly increased power and in a higher efficiency of the fuel. If all the gasoline used in this country were to be treated with this tellurium compound, it would be necessary to develop new sources of supply of tellurium and build plants for making the compound. The present production of the metal is very limited.

New Aluminum Alloy

A NEW aluminum alloy has been developed in Germany, which is sold under the name "silumin." The alloy contains 11 to 14 per cent of silicon and 86 to 89 per cent of aluminum. Its specific gravity is 2.5 to 2.65; tensile strength, 20 kilograms per square millimeter, and hardness at room temperature, 60 kilograms per square millimeter, with a 500 kilogram load and a 10 millimeter ball. The alloy is unaffected by wet steam, and resists concentrated nitric acid better than aluminum, which it resembles very much. The alloy is made from its elements directly or in the electric furnace. For further details, see the "Chemiker Zeitung," December 22, 1921.

Soda Lake in Siberia

THE discovery of a lake, rich in carbonate of soda, in the neighborhood of Kulumda, Siberia, has been announced. The lake is located in a very fertile region, and active steps are being taken to exploit the discovery and erect a soap factory in the immediate vicinity of the lake.

Mercury and Its Use

THE principal mercury mineral is cinnabar, which is mercury sulfide. The smelting of the mineral takes place in furnaces or retorts. In the furnaces the mineral is subjected to direct contact with the flame from the fire-box, and the volatile products of combustion, mixed with a certain amount of dust and vapors of mercury, escape from the furnace into the condensers. In the retorts the mineral is heated indirectly and the products of the distillation are not contaminated with dust and other impurities from the hot flames. The furnaces are used especially for treating rich ores, and are very economical, while the retorts are used for ores that are not so rich in mercury.

The uses for mercury are as follows: First in the manufacture of various pharmaceutical products, such as calomel, corrosive sublimate, colloidal mercury, etc. The oxides of mercury are used in the manufacture of acetic acid and phthalic anhydride as catalysts. Mercury is also used as a catalyst in the manufacture of picric acid directly from benzol. Fulminate of mercury, made by the combined action of alcohol and nitric acid on mercury, is used as the principal detonating explosive for military and commercial purposes. Fulminate of mercury is the main constituent of blasting caps. Sulfide of mercury is the well-known, brilliant red pigment, vermilion. Metallic mercury finds use in many electrical and thermal instruments, such as thermometers, the mercury arc light and rectifier of alternating current; various physical instruments such as barometers, manometers, etc., are made with the aid of mercury. It is also used as the cathode in the manufacture of various products by electrolysis, as, for example, in the manufacture of caustic soda and chlorine from common salt.

Moving a school-house and pulling old stumps with tractors—work that is not usually expected of such machinery

Jobs for the Tractor Outside the Daily Routine

EVERY tractor owner knows that, with a little ingenuity, he can do a lot of things with his machine that are not in the books. The general notion of doing unusual things with a tractor is indeed an old story; but this does not mean, necessarily, that some particular display of tractor-operating ingenuity is not on its own merits of interest. Two such items we illustrate at the head of this page.

The Litchfield, Neb., schoolhouse had its moving day not so long ago. Instead of adopting the more traditional procedure of hauling it with stationary engine and winch, the contractor decided that he would get it moving and keep it moving. So after he got it jacked off the old foundations he constructed a good sledge-and-roller arrangement under the building, and when the tractor shown in the picture was eventually harnessed to the schoolhouse it walked right away with it. Communities that have had a street blocked for weeks by a house-moving job might profit from this example.

A job that happens more often than house-moving is stump-pulling. Where a 12-25 horsepower machine was none too husky for the larger task, the cut-over land may have its teeth pulled with the aid of a smaller machine—the one performing before the camera is of 5-10 horsepower rating, and, as the picture suggests, it is of ample power for the task.

How the Stability of a Ship is Determined

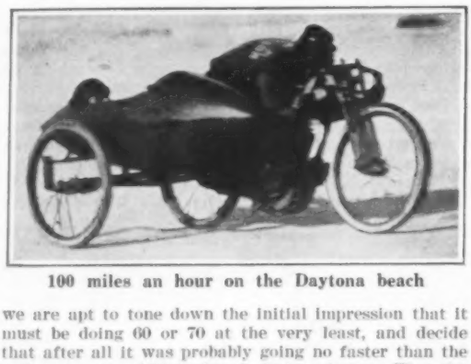
THE U. S. S. "California," as many of our readers know, is one of our new vessels which is so heavily armored and so adequately protected that her designers believe she could withstand the blow of a 4000-pound bomb. Three of her sister ships are already complete and in commission. Our present photograph shows her before the superstructure was built up, while she is being submitted to what is known to the technical expert as the "inclining experiment." Tracks were laid across the vessel, on which cars carrying heavy loads of steel, some 20,000 pounds in weight, were drawn from side to side. The object of this experiment, which is a perfectly normal operation in the construction of every ship, is to discover how the vessel lists or heels under various positions of the load. In this way her stability and her medicentric height are determined. This is always an important consideration in obtaining a steady gun platform.

The "California" is tested for her stability by means of loaded cars run on tracks from one side of the vessel to the other.

One Hundred Miles per Hour

THE visual impression of speed is not always to be trusted, as is well known by any motorist who has made the interesting discovery that 30 miles per hour in a flivver looks about as fast as 50 in a heavy six. It is not merely the greater vibration and the more pronounced jumping of the smaller car that add to its apparent speed; the very size of the large object makes its motions seem more deliberate. The baseball fan knows well that a huge bulk like Hans Wagner, Napoleon Lajoie, or the immortal Babe Ruth looks like a veritable ice-wagon on the base paths, but none the less covers the distance from second base to the plate about as fast as the smaller and more graceful man.

And so when a motorcycle shoots past us on the road,



100 miles an hour on the Daytona beach

we are apt to tone down the initial impression that it must be doing 60 or 70 at the very least, and decide that after all it was probably going no faster than the ordinary automobilist when he is in a hurry. That the motorcycle really is capable of extreme speeds we will, however, realize if we recall the ease with which the cop mounted on one overhauls all but the very fastest and most recklessly driven cars. And here is a picture that gives further evidence of what the motor bike can do, even when trammeled with a side car. It was taken on the sand at Daytona, and in spite of the fastest of shutters and the briefest of exposures, shows the object considerably blurred and distorted by motion. The speed in this particular case was 100 miles per hour, as indicated by speedometer on the machine. Needless to say, the gentleman is not driving for his health; he is in fact tuning up for one of the races for which the sands of the eastern Florida coast are so admirably suited, and which in turn have contributed to the fame of these beaches.

Tests of Manila Rope

THE Bureau of Standards has recently issued Technologic Paper No. 198 on this subject. It is ready for distribution by the Superintendent of Documents, Government Printing Office, Washington, D. C.

The results of tests on manila rope discussed in this paper represent some of the data which have been accumulated at the Bureau during the past few years. Most of the specimens were submitted by various rope manufacturers on purchase orders for government departments and a fixed procedure was adopted by the laboratory in testing all of them. The rope ranged in diameter from ½ to 4½ inches, inclusive, and consisted of commercial 3-strand, regular lay ropes. The breaking load, weight per linear foot, number of yarns, and the lay of the rope and strands as well as the elongation, were measured. The average breaking load was found to be approximately a quadratic function of the diameter of the rope. It is expressed quite closely by the equation

$$L = cd\ (d+1)$$

in which L is the load in pounds, c is a constant equal to 5000, and d is the diameter of the rope in inches. The ropes showed a continually varying modulus of elasticity and no well-defined proportional limit. The number of yarns composing a rope may be expressed approximately by the equation

$$N = kd\ (d + 0.4)$$

where N = the number of yarns, k is a constant equal to 50, and d the diameter of the rope in inches.

The test results cover sufficient range and show such consistency that it is believed that the formulae deduced may be used safely for 3-strand regular lay manila rope of sizes between ½ and 4½ inches in diameter.

Spectrum Transmission Data

SCIENTIFIC Paper of the Bureau of Standards, No. 418, entitled, "Spectroradiometric Investigations of the Transmission of Various Substances, II," gives transmission data in the spectrum extended from 0.6 microns to 3 microns using a mirror spectrometer, a quartz prism and a vacuum thermopile. The substances examined are a series of mineral, animal, and vegetable oils (containing fatty acids,) nitrocellulose, bakelite, and selenite. It is shown that the absorption spectra of the oils are so nearly identical that they cannot be used for detecting the adulteration of one oil with another. The paper concludes with an examination of the accuracy of the author's previous work using a rock salt prism. It is found that using the recently determined refractive indices of rock salt, the corrections to the observations of 1903 to 1905 are of the order of 0.01 microns to 0.02 microns and hence negligible. This paper is now ready for distribution, and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.

Hot Weather Sunshades that Sit Over the Hat

TOURISTS in Greece during the past summer have been struck by the "hot hats" offered on the streets of Athens. They are of light silk or muslin, without a crown of any description, as they are built over a large, light frame that fits over the regulation hat. Though known under the name of hats, they are in better truth sunshades. They are said to lessen materially the discomfort of the Mediterranean sun, and to be in general use in Greece. Perhaps we shall yet see them on this side of the ocean.

The trick "hats" of the heated season in Athens

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Asphalt vs. Concrete

To the Editor of the SCIENTIFIC AMERICAN:

It goes without saying that readers of the SCIENTIFIC AMERICAN are always entertained and instructed, but it must happen sometimes that your writers get the wrong slant. In the issue of October 1st, page 230, is an editorial on "The Illuminated Highway," which contains the following statement: "Today we admit, even when we do not build our roads of concrete, that concrete is the stuff for roads." This statement, made without qualification, leaves out of consideration some very important points to which I am sure you will give due weight as I bring them to your attention:

In constructing a concrete road, the question immediately arises as to whether the concrete should be unsurfaced with any other material or should have an asphaltic top such as is customarily laid in all of the principal cities and on a large portion of our country highways. If the asphalt surface is applied, a very marked saving in the amount of cement is effected for the reason that when concrete is used for a foundation it requires only one part of cement to nine parts of sand and stone, while the general practice in constructing an unsurfaced portland cement concrete road is to use one part of cement to four and one-half parts of sand and stone. For a mile of 18-foot road 7 inches thick about 4000 barrels of cement are required. A saving of approximately one-half of the cement requirement is very well worth while, for with cement at, say, $2.50 per barrel this saving would be about $5000. Furthermore, the base would be thinner because of the asphalt top and would thus effect a still greater saving.

Not only is there a difference in the cement requirements, but engineers generally are turning to metal reinforcement for portland cement concrete roads where no asphaltic top is applied. Pennsylvania is laying most of its state highways with heavy metal reinforcement, and in North Carolina a decision has been reached to increase the metal reinforcement requirements to 100 pounds per 100 square feet. On this latter basis the cost for reinforcing metal alone would be $4750 per mile. With the asphaltic top no such reinforcement is necessary. From this you can see that the cost of laying a pavement combining all of the good points of portland cement concrete and of asphalt is very little greater than the cost of laying unsurfaced portland cement concrete and no greater than the cost of the latter if it be reinforced with metal.

There are today over 500,000,000 square yards of asphaltic pavements in cities alone, and their excellence is indicated by an extract which I quote from the official report of the Engineer Commissioner of the District of Columbia for the fiscal year ending June 30th, 1920: "The average age of [asphalt-paved] streets resurfaced in 1910 was 25.8 years; in 1911, was 24.5 years; in 1912, was 25.8 years; in 1913, was 26 years; in 1914, was 28.5 years; in 1915, was 28 years; in 1916, was 29.6 years; in 1917, was 27 years; in 1918, was 26 years; in 1919, was 26.7 years; in 1920, was 23.6 years."

I have no desire to speak in derogatory terms of unsurfaced portland cement concrete pavements, but, in advocacy of the asphalt top, I would call your attention to the well known fact that portland cement concrete is very porous, readily absorbs water and if not protected by some waterproof covering is subjected to an extreme amount of expansion and contraction. When the concrete slab is laid directly upon an earth subgrade, the slab is subject to the most trying conditions because of the difference in the moisture and temperature conditions of the upper and under side of the slab. If an asphaltic top is applied, the concrete slab receives a maximum protection against temperature and moisture changes. In the absence of such a top the concrete slab is ultimately shattered by the cracking due to expansion and contraction. I need only cite to you the experiences of the California and Maryland state highway departments, both of which have found it necessary to resurface a considerable yardage of portland cement concrete pavements after a service of five or six years. If the asphaltic top were applied at the outset, the repair would only be to the surface as the base would remain intact.

As an engineer you must know that apart from moisture and temperature changes the agency most destructive to highways is impact. A striking illustration of this was brought out in tests by the U. S. Bureau of Public Roads which showed that under given conditions a static load of 7500 pounds might deliver a blow equivalent to 20,000 pounds static load if the weight were represented by a truck wheel moving at speed of fifteen miles per hour and having a drop of ¼-inch, a condition not uncommon at joints in a portland cement concrete road. To oppose impact by a rigid slab is necessarily to choose a costly alternative where it is possible to adopt the simpler plan of opposing a cushion or flexible body to take up the shock. Asphaltic surfaces unquestionably possess the ability to absorb the shock or impact and give decided protection to the foundation. It is cheaper and more effective to use the asphalt top than greatly to increase and reinforce the portland cement concrete slab.

So successful has this material proven on the Pacific Coast that over 12,000,000 square yards of the all-asphalt pavement have been laid, in which asphalt has been combined with sand and stone to form the entire slab, resting in most cases upon a thin insulation course of broken stone. In Visalia, California, this type of pavement has been subjected to heavy traffic for 26 years with no maintenance cost and is still in good condition. There are hundreds of examples of long service with no maintenance cost for the all-asphalt type of pavement. I feel sure that you do not mean to discard these incontrovertible facts by stating that "we admit that concrete is the stuff for roads."

J. E. PENNYBACKER.

Not Fireproof

To the Editor of the SCIENTIFIC AMERICAN:

In looking over the November issue of the SCIENTIFIC AMERICAN my attention was arrested by the article on page 139, entitled "A Safety File for the Home," in which the statement is made that it is a "semi-fireproof filing cabinet for the home." Further on the statement is made that it "serves every purpose of a safe." We assume that the intention is to convey the impression that the cabinet will protect papers stored in it from fire, not that the metal box itself will not burn under ordinary fire conditions. When we know from actual test that we cannot secure fire protection for even one hour in a safe except by use of heat insulating material two inches or more thick, it does not require any guess work to say that a thin-wall metal box will afford so little protection as to be negligible. We all know how readily heat goes through the walls of a stove, and that paper laid against it will take fire. With the cabinet the condition is simply reversed, the fire is on the outside and the papers on the inside.

While we have not made a test of a cabinet of this form, we have tested ordinary metal vertical letter files, which, if anything, would probably afford more protection than the cabinet shown, with quick destruction of contents as a result. If the inventor or promoter has any doubts, let him put one of the cabinets in the fire box of the nearest house-heating furnace with a brisk fire in it and see how long the papers are protected. The result may be disappointment, but it will save him money and embarrassment.

We trust that our remarks will be taken in the spirit in which offered—to give helpful information about a subject upon which we are specializing and about which we find there is much misinformation, namely, the protection of records from fire. It is not uncommon to lose sight of the fact that more than incombustibility is required to provide fire resistance. Heat insulation also is necessary. As a matter of fact, a well-made hardwood box with walls one-half inch or more thick and with a good cover would afford protection for a longer time than a single wall box of thin metal, because of the better heat insulating properties of the former. Of course it would not afford protection for a sufficiently long time to be of any practical value.

M. L. CARR.

Marietta, Ohio.

What Not To Do to a Car

To the Editor of the SCIENTIFIC AMERICAN:

Having been an automobile owner for 17 years, on receiving the first SCIENTIFIC AMERICAN MONTHLY I read at once the "pointers" by Harold Hollingshead.

Some of his advice is very unorthodox and some of it would be dangerous if taken seriously by those who believe that everything in print is "law and gospel," and especially so when it appears in the SCIENTIFIC AMERICAN.

I will mention some of the things that he advocates that no well-informed owner would think of practicing or permitting.

Oil is recommended as a cure for leaky tire valves. Certain parts of valves are made of rubber, and anyone who wants to find out what oil does to rubber can easily do so. Tire manufacturers say "Keep oil away from tires." Oil in a valve causes no end of trouble and should never be resorted to without realizing that the valve "inside," at least, will be ruined. Power tire pumps are furnished with devices to filter the air free from oil, and such filters are not provided for the fun of it. "There's a reason."

In these days of heavy fuel and diluted crank-case oil, automobile manufacturers conspicuously display on cars and elsewhere this admonition: "Change oil every 1000 miles." Sometimes they advise a change of oil every 500 miles.

It is therefore astonishing that anyone should recommend a time instead of a mileage basis. Crank-case dilution depends on the number of miles run, kind of fuel used, and on several other factors, but time is not one of them. Mr. Hollingshead must have a "little refinery in his home" that keeps him supplied with old-fashioned 80-degree fuel that does not cause dilution.

Flushing radiators every two weeks is about twenty-five times oftener than is done on most cars where cooling systems give no trouble.

Spark plugs ought to run months instead of weeks without cleaning. "Emery on the points" is never needed. At all times the points are burned perfectly clean where the spark occurs. Any perfect spark plug will only need to have the loose carbon scraped off and the insulator or porcelain perfect and clean.

Neatsfoot oil is all right for a leather clutch, which is probably what the writer meant, but he does not say so.

Mr. Hollingshead says, near the close, "In starting and stopping at all times shift to low or intermediate gears, which will save the strain which would come on the motor by pulling in high gear." I have wasted (?) hours over the fourth dimension and Einstein, but now I can transfer my attention to this problem of stopping in low gear or intermediate.

Mr. Editor, were those serious and honest-to-goodness "pointers," or are you running humorous articles incog? The SCIENTIFIC AMERICAN has been, and, judging from the first issue of the Monthly, is going to continue to be, indispensable to me. I had no idea, however, that it was going to contain a comic department.

Hartford, Conn. CHAS. EDW. PRIOR, JR.

Authority and Usage

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest an editorial on page 178 of your issue for September 10th on "Technical English," in which you take exception to the frequent use of "data" as a singular. Such use is, of course, grammatically wrong, though somewhat justifiable psychologically if one sees "data" with his mind's eye on a single column of figures. I suppose after all grammar is but a matter of psychology, so that, by usage, "data" can be made both singular and plural. The word "datum", if used by the man on the street, sounds pedantic, does it not?

I have before me the "Standard Home and School Dictionary," 1911 edition, revised and enlarged by Prof. C. M. Stevans, Ph.D. The entry under "data" is as follows: "Something given or admitted; some fact, proposition, quantity or condition granted or known, from which other facts, propositions, etc., are to be deduced." Thus, Professor Stevans apparently discards "datum" altogether and would have the public use "data" in the singular.

This and the many questions concerning business English leads me to suggest what I have often thought of before—an academy for the English language which might have headquarters in England but a live branch in America. I believe that the professors of English throughout the country, on the whole, would oppose such an academy, but that the man on the street would not. I believe, however, that if it were established there would be latent desire on the part of many professors of English to become members.

Suppose, then, we start this academy. Suppose you and I become the initial members and then surround ourselves with a half dozen others, so as to make a real beginning. As I do not profess to be competent to set a standard on requirements in the use of English, but only to be a target for questions, I should like to make a proviso that my membership in the academy should cease at the first annual meeting and I be eligible for election only after the academy has been going for a definite fiscal year.

This is but one of several moves on my part for disposing of many questions that are afloat. As I see it, the world needs people with *initiative* to pave the way; while there is plenty of *ability* to follow. G. W. LEE.

Boston, Mass.

Wanted:—Science Jingles

To the Editor of the SCIENTIFIC AMERICAN:

I am endeavoring to collect verses of a more or less humorous nature, whose subject-matter relates to the sciences, with the intention of publishing an anthology of such poetry, under the title of "Jingles of Science." It has occurred to me that there may be a large amount of such poetry filed away by some of the great number of chemists, physicists, engineers, and others interested in scientific matters. This material is quite unavailable to me at the present time, by reason of its non-publication. Will you kindly grant me space for this appeal to your readers to send me copies of such verses as are available to them, and which in their opinion are worthy of publication? Whenever possible, I should like to have the name, or names of the authors accompany each contribution. Any verses, grave or gay, referring to any of the sciences, sent to me at 7 St. Paul St., Cambridge, Mass., will be sincerely appreciated, and duly acknowledged. CHARLES E. RUBY.

7 St. Paul St., Cambridge, Mass.

The Heavens in May, 1922

The Extreme Accuracy with Which Our Measures of Star Distances Is Conducted

By Prof. Henry Norris Russell, Ph.D.

THE astronomer, perhaps beyond other students of nature, has a passionate interest in precision of observation. Accuracy of measurement is of course worth while for its own sake—though only those who have tried it know what a multitude of pains must be taken to improve upon the successes of the past. But the student of the stars is always tantalized by the realization that some further advance of knowledge—perhaps long and eagerly desired—lies just out of reach, so long as our observations remain what they are, and would come within our grasp could we but make our measures more precise.

A very good example of this steady search after methods of ever higher precision is found in the history of the measurement of the distances of the stars. The principle involved—the apparent shift of the star's position in the sky, as the earth swings from side to side of its orbit—has been fully understood for two centuries. The long struggle has been a matter, not of theory, but of practice; and the student of observing conditions and the designer of instruments have won the battle.

A century ago, the only way to find out where a star was in the sky was to measure its distance from the pole, or from the zenith, with a meridian circle. When such large angles have to be measured, an error of one thousandth of one per cent may amount to a whole second of arc—which is far larger than the whole parallax which we are seeking. It is not surprising, therefore, that the relatively imperfect instruments of a century ago did not prove equal to so delicate a task. Success came when Bessel, with his newly invented heliometer, started to measure the distance of a star from its near neighbors in the sky, and to detect the changes in these caused by the paralactic displacement; for these were small distances, comparatively, and the same percentage error in them did not amount to nearly so much.

Things to Watch Out For

Nowadays, when we take photographs of the stars with great telescopes, and measure the images upon our plates, the gain both in speed and in accuracy is very great; and we seem near mechanical perfection in our processes. But are our results really as accurate as they look, even though successive observations on the same star agree excellently well? Or is there some concealed source of error, which still lies lurking in our observations? If we were not very careful, there certainly would be. For example, our star is most shifted by parallax when it is 90° from the sun in the sky. If we want to observe it then, we will find it in the west after sunset, or in the east before sunrise. The effects of refraction of light in our atmosphere will be different in the two cases. This would not matter if they were the same for all the stars in our photograph; but for stars of different colors they are different. Our photographs, therefore, if taken at these times, would exhibit spurious shifts, due to refraction, confused with the real shifts, due to parallax. To be sure that we are rid of these, we must take all of our plates, morning and evening, when the sky is in the same part of the heavens (say on the meridian), even if we have to observe it when the shift due to parallax is considerably smaller.

Again, it is found by experience that, in order to get the greatest accuracy of measurement, the images of our stars must be correctly exposed. If they are over-exposed (deep and fuzzy) or under-exposed (gray and feeble), the measures will be inferior. Various ingenious screening devices have therefore been used, to cut down the brightness of the principal star and make its photographic image of about the same intensity as the others, so that the exposure can be made correct for all at once.

But when these precautions and many others have been taken, have we got rid of all our errors?

The first, obvious, test is to compare the results obtained by two observers. There are many stars for which the parallax has been determined at two or more observatories. The individual measurements do not agree exactly—and this is not alarming for no single determination can be free from all error. The more important question is whether the results of some observers tend, on the average, and all the time, to come out larger than those of others. Careful investigations by Boss, van Maanen, and other astronomers show that it is probable that minute differences of this character exist. For example, the parallaxes determined at Allegheny Observatory are, on the average, a little smaller than those found for the same stars at Mount Wilson. But the differences so revealed are most gratifyingly small, amounting at most to a few thousandths of second of arc.

Small as these differences are, they must be taken into account in the most refined work—but the question then arises: If different observers disagree, even minutely, which is right (or most nearly right)? A very ingenious attempt to solve this hard problem has just been published by Strömberg, who has long been associated with Adams in the work on spectroscopic parallaxes at Mount Wilson. As may be remembered, these spectroscopic parallaxes are derived by estimating the true brightness of a star from its spectrum. They may be in error, but the error will be proportional to the parallax itself, and not a fixed amount, as in the cases of which we spoke earlier.

Checking One Method Against Another

Suppose now that all our measurements of parallax are too large, on account of some unexplained error, by a fixed but unknown amount. The spectroscopic parallaxes, which are adjusted to match the direct measures, will then also be too large; but in this case the error will be greatest for the large parallaxes, and least for the small ones, so that the two sets of parallax determinations, though they agree on the average, will disagree, in opposite directions, for the large and small parallaxes, respectively. In this way it is possible to detect such an error, if one exists, and even to determine its amount.

Strömberg concludes that the spectroscopic parallaxes require corrections varying somewhat for the different spectral types, but amounting on the whole to an increase of 2½ per cent in their values; while the directly measured parallaxes measured by the various observers require corrections, some additions and some subtractions, but none exceeding 1/300 of a second of arc. The average of the four longest series of observations (at the Yerkes, McCormick, Allegheny and Mount Wilson Observatories) is correct within a thousandth of a second.

This is a most gratifying conclusion, and shows that the means taken to avoid the introduction of error into the observations have been highly successful. Our present determinations of stellar distance are amazingly accurate, when it is considered what minute quantities have to be measured. For example, 1/300 of a second, the largest correction found to be required, is equivalent to the angle subtended by 1/100 of an inch at a distance of ten miles. For distances up to 100 light-years, or rather beyond, our present direct methods of observation may be regarded as satisfactory; while the spectroscopic method, which is also thoroughly trustworthy, may be applied to a distance ten times as great.

At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.
At 9½ o'clock: May 30
At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

As our map shows, the winter constellations have quite vanished except for Gemini, which is setting in the northwest. Leo is still well up in the west, and Virgo is high in the southwest—brightened by the presence of Jupiter and Saturn. Corvus, Crater and Hydra are below, the latter stretching parallel to the horizon through a whole quadrant of the heavens. Scorpio is rising in the southeast, and Centaurus is on the meridian. Only the northern part of this constellation is visible in our latitude, but observers in the tropics can see, at this season, its two brightest stars, low on the horizon. Boötes is overhead, and Ophiuchus and Serpens occupy most of the southeast. Hercules and Corona are high in the east. Lower down Cygnus and Aquila have just risen, with Lyra above the former. Cepheus and Cassiopeia are low in the north, while Ursa Minor and Draco are higher, above the Pole, and Ursa Major higher still, northwest of the zenith.

The Planets

Mercury is an evening star this month, and is unusually well placed for observation around the 23rd, when he is at his greatest elongation, 22½° from the sun, and more than 25° north of the celestial equator. He is in the constellation Taurus, and appears as bright as Capella or Procyon, remaining in sight until 9 P.M.

Venus is an evening star, a little higher in the sky than Mercury, and about forty times brighter. During the latter part of the month Mercury will be within five or six degrees of Venus—below her and to the right—and will therefore be very easy to find, though the glare from Venus will tend to obscure his real brightness.

Mars is almost as far south of the equator as the other two planets are north, and therefore rises late, although he is nearing opposition. By the end of the month, however, he puts in an appearance at 8:20 P.M., and is conspicuous in the late evening. He is in Sagittarius, moving slowly westward into Ophiuchus, and brightens steadily until he surpasses Sirius and almost equals Jupiter.

Jupiter and Saturn are still close together in Virgo—the former being about 8° farther east—and are conspicuous until the small hours. The former sets at 2:20 A.M. and the latter at 3:00 A.M. in the middle of the month. Uranus is in Aquarius, and rises at 2 A.M. on the 15th. Neptune is in Cancer, and sets a little after midnight on the same date.

The moon is in her first quarter at 8 A.M. on the 4th, full at 1 A.M. on the 11th, in her last quarter at 1 P.M. on the 18th, and new at the same hour on the 26th. She is nearest the earth on the 8th, and farthest away on the 19th. During the month she is in conjunction with Neptune on the 4th, Saturn on the 7th, Jupiter on the 8th, Mars on the 13th, Uranus on the 20th, Mercury and Venus on the 28th—a pretty sight before dawn—and with Neptune again on the 31st.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

CAP.—L. KRONTHAL, 314 W. 94th St., New York, N. Y. This invention relates to a cap which is so constructed as to be applicable to heads of various sizes. An object is to provide a cap construction which includes means of adjustment for limiting the radial expansion of the head-receiving opening, and means cooperating therewith for holding the cap to snugly fit the head of the wearer.

GARMENT MARKER.—A. R. PRICE, c/o Gebhardt Scudder & Hendrickson, Spalding Bldg., Oregon City, Ore. The object of the invention is to provide a device which is adapted to effectively mark the garment, which while demountable may be readily set up and accurately adjusted, and which is in general of simple and durable construction, reliable, easy and inexpensive to manufacture, and susceptible of advantageous use by a single operator.

GUARD SOLE FOR SHOES.—A. M. GLUCK, 948 Union Ave., Bronx, N. Y. The invention is designed primarily for use with bathing shoes, an object being to provide a guard sole which will protect the feet of the bather from pebbles or shells, and will serve to prolong the life of the shoe. A further object is to provide a flexible guard sole, made of some metal, such as aluminum, which is light in weight and strong enough to be durable.

Chemical Processes

PROCESS FOR TANNING LEATHERS AND SKINS.—H. MORIN, address J. Bonnet-Therion, 95 Boulevard Beaumarchais, Paris, France. The invention relates to a process for white tanning leathers and skins. The process consists in the incorporation with the cells of the skins, whatever may be their origin and their nature, of silica or oxide of silicon which, combining with the constituent elements of the skin, forms with them an insoluble imputrescible composition.

Electrical Devices

CONTROLLER FOR ELECTRIC MOTORS.—G. E. ADAMS, 660 Maryland St., Gary, Ind. More particularly the invention relates to manually operated controllers, used in starting direct current motors. The main object is to provide a device by means of which the starting resistance may be shorted out gradually as the motor comes up to speed, regardless of how fast the handle is thrown around, or regardless of what load the motor is required to start with or what the line voltage is.

Of Interest to Farmers

TRACK CONSTRUCTION.—W. W. WHEELER, c/o St. John Hotel, Columbia, S. C. The invention relates particularly to a track construction especially designed for use in the system of planting, cultivating and gathering crops. The purpose is to provide a construction which is simple, inexpensive and extremely durable to withstand the weight and wear of machinery passing over the tracks during the planting, cultivating and harvesting of the crops.

CONVEYING APPARATUS.—C. FREDRICKSON, 29 W. Marshall St., Rice Lake, Wis. An object of the invention is to provide an apparatus which is especially adapted for the conveying of potatoes or other vegetables and fruit. Another object is to provide a main conveyor with cross conveyors, removably connected thereto, and provide an arrangement of doors, controlling the passage of the potatoes or other articles from the main conveyor onto any of the branch conveyors.

Of General Interest

EYE-SHADE.—W. K. MILNE, 251 56th St., Brooklyn, N. Y. The invention relates to protective devices for the eyes. The primary object is to produce a simple and cheap article which consists of independent shade members adapted to be respectively positioned to each eye and supported from the bridge of the nose. A further object is to produce a shade made from a single piece of semi-transparent material which is light and which is sufficiently small to render the same capable of being worn beneath a pair of spectacles.

TROLLING SPOON.—E. C. SELLECK, 423 Corbett Ave., San Francisco, Cal. The object of the invention is to provide a spoon or spinner which may be easily and cheaply manufactured and which will be attractive to the fish. The spoon is used in the usual manner, a shank is formed by bending a length of wire to form two strands with supporting loops for the spoon and hooks, the center of the wire strands being wrapped with silk thread of a brilliant color to represent the body of an insect.

THREAD AND IMPLEMENT HOLDER.—G. M. MYERS, JR., 635 King St., Charleston, S. C. The invention relates to the art of crocheting or knitting. An object is to provide a container of light material for holding balls or spools of crochet thread, which will feed the thread out as used to prevent it from becoming tangled or knotted during the crocheting, knitting or sewing operations. A further purpose is to provide a needle-holding means for securing the needle to the thread container, and means for conveniently attaching the container to the person.

DOUBLE-EXPOSURE AND BLANK-FILM PREVENTING DEVICE FOR CAMERAS.—H. J. FRIES, 1010 No. 11th St., Tacoma, Wash. The general object of the invention is to provide a simple device which may be readily applied to the shutter mechanism of cameras now in use as well as to those at the time of manufacture, for preventing a double exposure or blank film. The device is so constructed that it serves as a reminder to the user that the film should be turned. It is of a durable and lasting form and may be manufactured at a low cost.

CONVEYOR CONDUIT.—J. B. BROWN, address D. H. Hamilton, c/o Cross Country Bank, Wynne, Ark. The invention more particularly relates to a pneumatic conveyor conduit embodying adjustable telescopic sections. One of the principal objects is to provide a conduit so constructed and arranged that any possibility of the sections becoming jammed is effectively precluded, the sections being at all times easily and readily adjusted to vary the length of the conduit.

IRRIGATING VALVE.—J. A. NICKOLAUS, Richland, Wash. The purpose of this invention is to provide an irrigating valve which is so associated with the pipe line as to effect a perfect control of the water irrespective of its pressure in the pipe, and to allow the water to be emitted from the side of the pipe, thus preventing the wind from blowing the water off to the side of the rills while irrigating.

MANHOLE FORM.—F. L. YOUNG, 306 Pershing Ave., San Antonio, Texas. This invention has for its object to provide a form for concrete structures, especially adapted for building manholes and other tubular bodies having restricted outlets, wherein the form is composed of a series of sections so connected that they may be expanded to the desired diameter, and may be detached to permit their removal through a restricted opening.

EYESHADE.—W. A. CARLETON, Governor's Island, N. Y. Among the objects of the invention are to construct an eyeshade which will preclude "side glare," thus avoiding a common objection to devices of this nature, and to so construct the shield that it may be readily folded to permit of its being carried in the pocket or safely sent in an envelope by mail.

SMOKING PIPE.—W. CELEDA, 489 So. 15th St., Newark, N. J. The invention relates particularly to a pipe having means to catch the nicotine and prevent direct passage to the mouth of the smoker. The general object is to provide a nicotine chamber of ample proportion and so arranged as to insure the settling and deposit of the nicotine, and also to prevent the passage of saliva to the bowl as well as to cause the smoke to be cooled before passing to the mouthpiece.

PROCESS OR COPYING CAMERA.—A. FRUWIRTH, 54 Hart St., Brooklyn, N. Y. The invention relates particularly to copying cameras used for enlarging or reducing purposes. One of the objects is to present a complete unit involving a number of attachments and scales for substantially automatically securing the proper enlargement and proper focus, whereby a user may secure excellent results without the use of technical knowledge. Another object is to construct the camera in such manner that wabbling or loose motion will be eliminated.

SALES SLIP.—R. P. PACKARD, 702 So. Oakes St., Tacoma, Wash. An object of the invention is to provide a sales slip which is primarily designed to facilitate the tabulation upon an adding machine of the prices of articles which have been purchased and listed on the slip, by providing a slip having spaces so arranged that an adding machine may be conveniently used to tabulate the price of the articles so that the price will appear in the same space as the name of the article.

RAT GUARD.—W. F. KONIG, 5 Goodsell Place, San Francisco, Cal. The primary object of the invention is to prevent any possibility of a rodent utilizing the hawser of a ship when the guard is in applied position. A further object is to construct the device so that it shall be adjustable, and may be applied to various sizes of hawsers. A further object is the provision of a guard which may be applied to the hawser subsequent to the positioning of the latter between the vessel and dock.

BEDPAN.—B. MOSELEY, 107 So. Haroin St., Sumter, S. C. The invention has for its object to provide a pan having a cushion of rubber or the like for engaging the body of the patient to prevent shock from the cold contact, and to cushion the pan in such a way that the cushion may be removed when desired.

FENCEPOST ATTACHMENT.—P. T. BAILEY, P.O. Box 272, R.F.D. No. 2, Middletown, R. I. The invention relates more particularly to a construction or attachment for the top of fenceposts for giving an additional fence structure or giving an ornamental appearance to the complete fence. The object is to provide an attachment which may be mounted on fenceposts of various types. A further object is to provide an attachment which may be bent at an angle of 45, or more or less as desired.

FLY SWATTER.—C. G. COE, 127 East 17th St., Lawrence, Kan. The object of this invention is to provide a device adapted for connection with a closure of any character, as, for instance, a screen door, and controlled by the movements of the closure for operating the same. The device is in the form of a wire screen frame which is so arranged that it strikes the door when opened, killing any flies between the door and the frame.

WINDOW.—A. P. SCHOELLERMAN, Lake Park, Iowa. This invention relates to a window which is especially adapted for use as a sleeping porch or balcony window, or basement window as it is substantially rain and water proof, it is easily operable and particularly adapted to be associated with the construction of the building adjacent such parts. The device comprises a plurality of hinged sash sections closely nested, to extend over a comparatively short distance laterally when opened.

MILK COVER.—C. W. MCLEAN, R.F.D. No. 1, Shavertown, N. Y. The general object of the invention is to provide a simple, inexpensive device capable of use in filtering milk into milk cans, to cool the milk as it is discharged into the can. A further object is to provide a device of this nature capable of ready and quick connection with, and disconnection from, a milk can.

STREET INDICATOR.—W. L. CLARKE, JR., 690 East Call St., Tallahassee, Fla. A purpose of this invention is to provide a street indicator which is operable by the controller lever of a car so that the motorman during manipulation of the controller as the car is passing from one street to another will automatically actuate the indicator to apprise the passengers of the name or number of the next street in advance and before the car has reached such street.

SIGN.—J. J. DOOLEY and T. NILAN, 213 Beach 118th St., Rockaway Park, N. Y. The object of the invention is to provide a sign consisting of letters, numerals or characters, more especially designed for use on the ground at railroad stations, cemeteries or other places to designate the place in a simple and ornamental manner. Another object is to provide a practically indestructible sign which may be embellished with a filling of cement, mosaic, dry stone, chips of various colors, pebbles, or soil in which grass, flowers or plants may be grown.

HIGHWAY TRACK.—C. T. ELDREDGE, 3750 24th St., San Francisco, Calif. Among the objects of the invention is to provide a steel track adapted to be fitted into a concrete road bed without causing the concrete surrounding it to chip, and at the same time to fortify the concrete so that the whole will resist severe strains brought to bear on it, the track being grooved in such manner that the tire of an automobile will not slip on it.

WINDOW CONSTRUCTION.—P. BOLOGH, 494 Hudson St., New York, N. Y. This invention has for its object to provide a pivoted window construction which is rigid, compact, efficient and at all times waterproof and will prevent a leakage at the joints particularly around the pivot point. The various parts can be made of any suitable material, but preferably of sheet metal.

WATCH CASING.—S. BRUNER, 64 Fulton St., New York, N. Y. The general object of the invention is to provide a watch casing in which the movement holder is enclosed and which has means for cooperating with the covers of the casing to hold the movement holder centrally spaced with respect to the covers when they are opened, and means in conjunction with the movement holder to assist in the opening of the casing.

STUDENTS' BOOKHOLDER.—W. COHEN, 68 West 17th St., Bayonne, N. J. The invention relates particularly to a construction adapted for use by students, and has for an object to provide a device wherein one or a larger number of books may be held in a clamped or bound position. A further object is to provide a holder to take the place of the usual straps or other carrying means, and will act as a rack for supporting the books on a desk.

FOOD COMPOUND.—J. A. LAWSON, 244 Kearney St., San Francisco, Calif. Among the objects of the invention is to provide a food compound which will act as a substitute for butter as well as shortening and like compounds. Broadly speaking, the compound includes about 82 per cent oily or fatty substance, combined with about 16 per cent cereal extract, and 2 per cent salt, with or without coloring or preservative, or artificial flavoring.

COMBINATION BABY CHAIR AND CRIB.—R. H. HOLMES, 7 No. Pryor St., Atlanta, Ga. The object of the invention is to provide a baby chair or crib adapted for use either outdoors or indoors, and to provide a support or frame for suspending the same, which may be compactly folded for shipment or transportation. The device may be easily carried from place to place or accommodated in an ordinary trunk.

ATTACHMENT FOR PIPES AND CIGAR AND CIGARETTE HOLDERS.—N. B. PANOFF, 54 E. 7th St., Brooklyn, N. Y. This invention relates more particularly to means for facilitating the cleaning of the stem. Among the objects is to provide a lining adapted to be fitted in a stem having means for removably securing it in position in a manner that the removal of the lining from the stem and the cleaning of the same may be done with ease.

ADJUSTABLE FOOTSTOOL.—M. WEINGARTEN, c/o Loudon Shoe Co., 110 Duane St., New York, N. Y. An object of the invention is to provide a simple and efficient stool which can be readily disposed in a convenient place, under a chair, and out of the way, when not in use, but which

can be quickly adjusted in an operative usable position with reference to the chair or other support when it is desired to use it.

FERMENTING TANK.—W. H. NOE, address James Dempsey, 105 So. Division St., Peekskill, N. Y. The invention relates to fermenting tanks more particularly intended for the fermentation of yeast, the foaming of which is particularly persistent, making it difficult to confine it to the tank and prevent its overflowing. The general object is to provide a tank and appurtenances that will serve to confine the yeast or other fermenting material within limits.

SHIPPING CASE FOR CASKETS.—G. B. SEXTON, 159 Main St., Asbury Park, N. J. The principal object of this invention is to produce a case for shipping caskets which is capable of being collapsed for re-shipment when empty, and will then occupy approximately one-quarter its original bulk. A further object is to provide means in the form of hasps and bolts, for securing the case in both its set up and collapsed conditions.

CHURN STAND.—C. A. KIBBE, Terlton, Okla. The invention relates more particularly to a stand which is adapted to hold a churn or other receptacle. An object is to provide a stand which may be clamped to a table or other support and is provided with hinged walls capable of forming a receptacle when in vertical position and adapted to be folded flat upon the base and occupy but a minimum of space for storage or shipment.

CHECK PROTECTOR.—J. J. O'BRIEN, address W. S. Shanahan, 44 Court St., Brooklyn, N. Y. The invention relates to a check protector which is small and simple in construction and may be carried in the user's pocket or form part of a writing implement. The protector includes a stem, a toothed wheel, a housing adapted to enclose the wheel, and means cooperating with the stem and housing for effecting a longitudinal movement.

MIXING FAUCET.—W. MEIER, 1951 7th Ave., New York, N. Y. An object of this invention is to provide a hand-controlled faucet for mixing hot and cold water in which the flow and temperature of the water issuing from the faucet can be accurately controlled by a lever. A further object is to provide a mixing faucet which is especially adapted for use on sinks or shower baths, and which may be easily disassembled should repairs be needed. The same inventor has also been granted a patent on a Pedal Controlled Mixing Faucet, which is operable by a foot pedal, leaving the operator's hands free for other purposes.

LADDER.—F. M. DESAUSSURE, JR., c/o Peerless Folding Ladder Co., Greenville, S. C. The object of this invention is to provide a ladder that is rigid and safe in use, light, compact, easily extended to operative position and collapsed into small compass for storage or transport and withal presenting a ladder that is extremely strong irrespective of its weight and material of which it is made. A further object is to provide means for locking the ladder in open or closed condition.

REFRIGERATION SYSTEM.—J. B. LACY, P. O. Box 740, Victoria, B. C., Canada. Among the objects is to produce a circulation of air in rooms provided with refrigerating coils. An object is to provide a system having means for controlling the humidity or the relative amount of moisture in the air of the room, means being provided for giving ready access to the cooling pipes, so as to remove the frost deposit, or for inspection, or repairs.

REINFORCED CONCRETE WALL CONSTRUCTION.—G. L. RACKLE, 4372 E. Boulevard, Cleveland, Ohio. The invention relates to a structure which is economical to manufacture, convenient to ship, speedily erected, and requiring a minimum amount of material to make a strong wall with a maximum amount of air space, comprising a studding section disposed there between, the studding section having recesses for the disposition of dowel pins of twisted metal held therein by cementitious material.

CLASP.—E. R. NEBELING, 472 Fulton St., Brooklyn, N. Y. The invention pertains more particularly to separable fasteners for bracelets, necklaces and similar articles of jewelry. One of the objects is to provide a fastener securely held against accidental displacement when in the locked position. A further object is to provide a device of this character with a minimum of moving parts.

HAIR CURLER.—J. DE RUVÓ, 2783 Broadway, New York, N. Y. Among the objects of the invention is to provide a hair curler which may be utilized in connection with any length of hair—in fact, it may be applied to a head of hair of relatively short length to impart a wave or curl without injury to the hair. The device is constructed to use electric heat as a medium for the curling, without any injury to the head or hair.

CHICKEN FEEDER.—J. P. REGO, 650 Magellan Ave., Honolulu, Territory of Hawaii. The invention has for its object to provide a device in the form of a hopper, wherein a casing is provided for the grain, and a closure for the same, normally closed, but adapted to be opened by the weight of the fowls as they mount upon a movable platform to approach the feeder.

MOUSETRAP.—C. E. SPENCER, R. No. 1, Box 50, Ovalo, Texas. The invention contemplates the provision of a trap having a plurality of compartments, by which animals may be caught alive and which when initially set, will be subsequently reset each time an animal enters the same, thus obviating the usual attention required to traps which must be reset manually by the user for reuse.

Hardware and Tools

WRENCH.—W. LER. BONNELL, Box 405, Chickasha, Okla. The invention relates more particularly to a pipe and nut wrench. The object is to provide such a wrench structure whereby a lever means may be used in connection with a screw for advancing and retracting the movable jaw of the wrench. It is a further object that the parts shall be few in number, strong, and positive in action.

WOODWORKING TOOL.—F. R. SHUGART, 1713 9th St., Sacramento, Calif. The primary object of the invention is to provide a combination tool of simple construction which is formed of a single piece of metal and has three different cutting edges so arranged and constructed that the tool may be easily, conveniently and effectively used as a hatchet, an adz or a draw knife. The tool is properly balanced and may be easily changed from one use to another.

Heating and Lighting

LAMP GLOBE PROTECTOR.—H. C. GROH, 204 Belmont Ave., Newark, N. J. The invention relates to lamp globe protectors, for either oil or gas lamps, and has for its object to provide a simple device which can be readily attached to any type of lamp globe to protect the globe from the head of the flame, the heat being diverted from coming in contact with the walls of the lamp globe by a heat-distributing medium which operates to effect the uniform distribution of heat throughout the device.

WATER HEATER.—J. RICHARDSON, 710 Gillman St., West Berkeley, Calif. The particular object of the invention is to utilize the heat contained in waste smoke for heating water and to provide a tank which in combination with a particularly constructed furnace is adapted to present a large heat absorbing surface to the smoke. A further object is to provide means for supplying additional heat to the water in case the heat furnished by the waste smoke is not sufficient to bring the water promptly to the desired temperature.

OIL BURNER.—W. H. SCHROFF and R. A. GOUDIE, address R. A. Goudie, 5407 Broadway, Chicago, Ill. An object of the invention is to provide an oil burner having a fuel delivery tube adjustable toward and away from the discharge end of a nozzle in order to secure the proper mixture of fuel and air. A further object is to provide a battery of oil burners in which means are provided to adjust or shut off the individual burners at will.

OIL BURNER.—G. S. CLYDE, 7 Pierpont St., Brooklyn, N. Y. An object of the invention is the construction of a device in which, without any extraneous apparatus, a vehicle is provided having fuel which will result in an intimate commingling, minute sub-division and even distribution of the particles of the same, at the same time supplying elements which will induce combustion to a point at which the flame produced will be entirely non-oxidizing.

Machines and Mechanical Devices

ORE MILL AND THE LIKE.—H. T. WILEY, Bridgeport, Ore. One of the principal objects of the invention is to provide a mill which may be used for various purposes, such as crushing quartz, or grinding grain, the construction being such that only slight variations in construction are necessary to adapt the mill to various uses, the crushing process being accomplished by the operation of a gravity-actuated crushing member arranged inside of a vertical rotating wheel carrying inclined plates against which the crushing member operates.

AUTOMATIC CHUCKING MACHINE.—H. A. SCHWARTZ, c/o Defiance Machine Works, Defiance, Ohio. This inventor has been granted two patents of a similar nature. They relate to metal working machines of the high speed production type, the object being to provide a machine arranged to automatically and successively carry out on a single casting or a pair of companion castings or other pieces of work a plurality of different tooling operations, such as drilling, face tapping, reaming, champering, countersinking, and the like, according to requirements and without the required changing of the position of the work in the work holder. Another object is to enable a single, practically unskilled attendant to run the machine and take care of the work.

DRIP PAN FOR GAGE COCKS.—G. C. GRANTIER, 16 Pearl St., Hornell, N. Y. The invention relates to drip pans provided on boilers beneath the gage cocks. One of the objects is to minimize the liability of the clogging of the pan by freezing or otherwise. A further object is to so construct the plan that with water or steam directed into the same from the cock, there may be produced a characteristic sound which will indicate the water conditions of the boiler.

BUFFING OR POLISHING WHEEL.—A. LEVETT, 125 W. 12th St., New York, N. Y. The object of the invention is to provide a buffing or polishing wheel which is simple and durable, not liable to fray at the peripheral edge, and arranged to prevent the formation of unduly thick portions at the gathered in edge of the hub. Another object is to reinforce the material by the use of fibers, bristles, fine wire or other filaments.

WRIST PIN.—T. G. SAXTON, address P. G. Coleman, c/o International Piston Ring Co., 91 McKinley Ave., Brooklyn, N. Y. The invention relates to a wrist pin more particularly intended for use in connection with the association of connecting rods with pistons of an engine. An object is the construction of a device of this nature in which the hammering and oval wear of the parts will be eliminated. A further object is to provide a pin which will automatically take up any play which may come into existence.

COUPLING.—F. A. GIBSON, Box 185, Jupiter, Fla. An important object is to provide a belt coupling having means whereby the same may be readily and conveniently attached to the ends of a belt in such manner that the ends are not mutilated or punctured. A further object is to provide a coupling which will prevent accidental disconnection of the sections from the belt, but which may be readily disconnected when it is desired to shorten the belt or remove the same.

SPINDLE TIGHTENER.—J. MATTSON, General Delivery, Chicago, Ill. The invention particularly relates to a device for tightening and holding driven spindles in milling machines or the like, against longitudinal movement. An object is to provide a device having means for engaging with a spindle to adjust the latter relative to its bearings and to prevent longitudinal movement, without interfering with the functional movements thereof. The device is self, adjusting, preventing play between relatively moving parts on account of wear.

ORE JIG.—E. M. DAUGHERTY, Tuberculosis Hospital, Webb City, Mo. A purpose of the invention is to provide a supplementary jig which may be incorporated in a jig of the Harz type, or formed independently of the same and associated with the discharge end thereof, such jig including a sieve disposed in a horizontal plane, whereby provision is made for the free and very nearly equal action of the ore bed throughout the length of the screen, and thereby providing for free settling conditions and higher ore recoveries.

THRESHING MACHINE.—R. H. OWEN, 412 W. Mercury St., Butte, Mont. The invention relates to grain threshers and has reference more particularly to that portion of a grain separator carrying a threshing cylinder, the principal object being to provide one or more adjustable concaves for the threshing cylinder, which may be adjusted or set without moving the same from the separator.

OIL LIFT.—W. C. CUSHING, 1110 So. Carson Ave., Tulsa, Okla. The prime object is to provide an automatic valve of the swab type which will not only permit the free flow of the oil from below to above the swab on the down stroke, but which will also permit free flow from above to below the swab on the up stroke of all oil above exceeding the capacity of the lift while automatically cutting off the flow and retaining all of the oil thereabove within the capacity of the lift.

RELEASING DEVICE FOR AIR BRAKES.—W. W. WOOD, c/o Hotel Lohr, Lafayette, Ind. The invention relates to braking mechanism of the combined hand and pneumatic operated type, a purpose being the provision of a brake mechanism which is operable to allow the spring of the brake cylinder to release all parts of the brake gearing after a brake application by hand or air without the piston of the brake cylinder being moved from its released position.

CUTTER FOR TRANSFER RINGS.—G. T. TWIDDY, 617 Parsonage St., Elizabeth City, N. C. More particularly the invention relates to cutting mechanism adapted for use with the transfer mechanism of a knitting machine. The device includes a cup and a rotatable transfer ring in said cup cutting mechanism carried by the cup arranged for removing the edge of the fabric carried by the transfer mechanism upon rotation of the transfer ring.

PUMP PISTON.—J. E. EVANS, c/o B. F. Green, Kerosene System Sales Co., Drew, Miss. An object of the invention is to provide a pump piston which is especially designed for use with air pumps, but which may be used for pumping any suitable fluid, which consists of few parts, which may be easily assembled, and at the same time prevent the air or fluid from escaping around the piston on the pressure stroke.

DRUM.—J. E. W. FOGAL, Quincy Elevator Gate Co., Quincy, Ill. Among the objects of the invention is to provide a drum which is so constructed as to cause its load to be moved slowly at the start, the speed of travel being gradually accelerated to attain a uniform maximum speed, and then gradually decelerated to a dead stop, the drum being rotated at a uniform speed during the entire time.

DRINK MIXER.—C. VOGT, 2410 Ogden Ave., Chicago, Ill. This invention has for its object to provide a drink mixer adapted to be actuated by water power, and provided with means arranged to be operated automatically to control the flow of water into engagement with a movable part of the device. A further object is to provide a water motor and conduit leading thereto and automatic means for controlling the flow of water through the conduit to the motor.

ADJUSTABLE CHUTESPRING FOR TYPESETTING MACHINES.—B. SHIELDS, 500 Coney Island Ave., Brooklyn, N. Y. The invention relates to typesetting machines. Its main object is to provide means for mounting the chutespring on the assembler entrance plate to admit of vertical adjustments of the same, whereby matrices of various sizes may be accommodated between the assembler bucklers and the chutespring to minimize clogging and transposition in the line.

SNOW REMOVER.—S. QWAM, 840 75th St., Brooklyn, N. Y. Among the objects of the invention is to provide a snow-removing machine mounted upon a motor vehicle and operated by the engine of the motor vehicle to remove the snow and deposit it in a second vehicle for conveying the snow to a point of dump. A further object is to provide a snow remover which will quickly move along the ground and automatically pick up the snow.

DRYING MACHINE.—N. C. HEBO, 229 Tchoupitoulas St., New Orleans, La. This invention has for its object to provide a machine adapted for drying granular material of any character, wherein a series of coaxially arranged rotatable cylinders is provided, together with means for providing heated air and means for feeding the material into alternate compartments, the arrangement being such that the largest possible amount of heat is utilized in the drying.

FOOT VALVE FOR WELL CASINGS.—P. B. TURPIN, JR., c/o Georgia Supply Co., Tampa, Fla. The primary object of the invention is to construct in such a manner that it may be removably and adjustably secured within a well casing. A further object is to provide a foot valve which, when positioned, provides an airtight joint between the body of the valve and the well casing, thus greatly increasing efficiency.

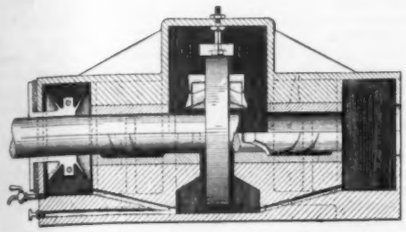


Fig. 1. Oil guide and dust protector invented by A. W. Minney

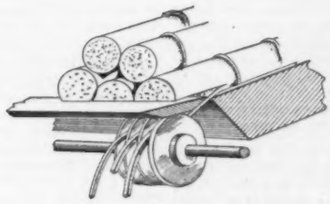


Fig. 2. Bamboo-shredding machine patented by A. H. Williams

Fig. 3. The respiratory apparatus designed by G. Anston

WELDING TABLE.—J. MURCHIE, 244 E. 8th St., Traverse City, Mich. The invention has for its object to provide a table of the character specified, especially adapted for oxyacetylene welding, wherein the table is so mounted that it may be inclined at any desired angle, with either face upward, and may be held in adjusted position without the possibility of accidental displacement.

TENSION DEVICE FOR SPOOLERS.—D. E. SKEDGELL, 5 Cliff St., North Tiverton, R. I. This invention relates to tension devices, and pertains more particularly to tension devices adapted for use on machines or other structures for spooling yarns. It is an object to so construct the device that as the strain upon the yarn increases the tension of the device is reduced.

WINDMILL.—A. J. CROWLEY, Box 393, Clayton, New Mexico. An object of the invention is to provide a device employing a plurality of vanes arranged to be operated by the force of the wind and their relative positions controlled thereby, as well as by manually operable means, whereby the windmill is operated at maximum efficiency under varying wind conditions.

LIFTING DEVICE.—J. JOLLY, 2008 8th St. W., Hutchinson, Kan. The invention relates to a mechanical device particularly adapted for removing plates or sections from a storage battery. An object is to provide a device by which a section of a storage battery including the usual positive plate assembly may be lifted from the battery jar without injury to the plates.

FILM CLEANING AND POLISHING MACHINE.—C. R. CARLETON, c/o Duplex Machine Co., 316 75th St., Brooklyn, N. Y. Among the objects is to provide a machine for treating strips of material, and more particularly for polishing and cleaning continuous strips of motion-picture films. The primary object is to produce a machine of this character which may be used for polishing newly-made films or for cleaning old or used films, particularly the emulsion side, without injury to the sensitized surface.

OIL GUIDE AND DUST PROTECTOR.—A. W. MINNEY, 231 E. Fremont St., Stockton, Calif. The invention has for its object to provide oil guides and dust protectors for bearings, and a bearing which may be packed with lubricant to provide for continuous lubrication, and which is so arranged that the oil cannot escape from the bearing. The device is adapted for use in any connection where it is desired to lubricate a bearing and prevent the entrance of dust, as, for instance, in saw, or flouring mills. (See Fig. 1.)

MEANS FOR CUTTING KERP IN MINING.—J. M. CHRISTINE, 1137 6th Ave., Ford City, Pa. This invention relates generally to the mining of minerals, and, more particularly, to means of cutting kerp with the chain-cutters of mining machines. The primary object is to provide a device which may be adapted to practically any type of mining machine now in use, whereby the kerp may be cut with more efficient results.

GRINDSTONE MOUNTING.—W. E. ROSEBUSH, Spokane, Wash. The object of the invention is to provide a mounting for grindstones, such as are used for pulp mills and other establishments, and arranged to securely hold the grindstone in position on the shaft or spindle and to allow of conveniently and quickly releasing and removing a worn stone without breaking it up, and replacing the same by a new one, thereby permitting the reusing of the worn stone in a mill requiring a stone of less diameter.

DOOR OPENING MECHANISM FOR ELEVATORS.—H. L. BRAYTON, 225 S. Howell St., Owosso, Mich. An object of the invention is to provide a door-opening mechanism which can automatically, simply and efficiently, be actuated by the operator of the elevator. Another object is to provide means whereby, when this appliance is used in connection with high-speed elevators, the operating parts are not injured by the shock or contact between the elevator and the operating parts.

DISHWASHING MACHINE.—C. E. WING, 424 College Ave., College Point, N. Y. One of the objects of the invention is to provide a machine for washing dishes in which washing fluid and rinsing fluid may be separately used. A further object is to provide means for separately introducing the washing fluid and rinsing fluid to the washing chamber, and mechanism whereby the dishes being washed are subjected to a spray of washing fluid from all angles.

BOTTLE-CRATING MACHINE.—P. K. COUK, 319 Mountain Ave., S. W., Roanoke, Va. Among the foremost objects of the invention is to provide a machine for placing bottles of any of the ordinary shapes into a sub-divided crate or container, either ends up or down. A further object is to provide a crating machine which advances a crate step by step so as to receive a charge of bottles at each step, and to provide means for automatically stopping the machine.

COMBINED CRUSHER AND MILL.—H. LOEVEN, 860 16th St., Douglas, Arizona. A purpose of this invention is the provision of a combined crusher and mill which is constructed to automatically effect the return of over-size ore to the mill so as to cause a further reduction of the ore to the required degree of fineness in a single, continuous operation.

TRANSMISSION.—H. BUSH, R. F. D. No. 2, Linnton, Oregon. This invention relates generally to power transmission and more particularly to a transmission for wave motors. The object is to provide a gear mechanism adapted to receive driving power from two different sources, to combine the two powers into one and then transmit it as a single power to the machinery which it is desired to drive.

OIL SEPARATOR.—E. J. BEACH, 55 Green St., Brooklyn, N. Y. The object of the invention is to provide an oil and air separator especially adapted for use in connection with compressors, the arrangement being such that the sealing oil in the compressor is relieved from its air without interrupting the compressing or without necessitating the use of a large amount of oil. A further object is the provision of a baffle and a straining member, arranged in such manner as to permit the passage of air without appreciable back pressure while causing a thorough separation of the air and oil.

MACHINE FOR SHREDDING BAMBOO AND THE LIKE.—A. H. WILLIAMS, Plant City, Fla. The invention particularly relates to a machine for the shredding of bamboo from which brooms and other articles are to be made. A further object is the provision of a machine which in one operation will make straws out of which the brooms are to be manufactured, and wherein the bamboo or similar material is shredded by reciprocating lengths thereof over suitably arranged means for accomplishing this purpost. (See Fig. 2.)

COTTON CLEANER AND SEPARATOR.—C. HILLMAN and S. SIEMS, Box 234, Runge, Texas. The object of the invention is to provide a device wherein all dirt, trash and the like is separated from the cotton by means of suction, the cotton being fed to the machine in a light, flocculent mass, which permits all dust and the like to be thoroughly separated from the cotton, and without twisting or tangling the cotton and without converting it into short staple by tearing the fibers.

PUMP VALVE.—W. J. NOTT, Franklin Terrace, West Croydon, South Australia, Australia. This invention relates to pumps for lifting water and other liquids. According to the invention the valve seatings, that of the foot valve and the plunger valve, instead of being square across the barrel of the pump, are formed obliquely thereto; and in addition the plunger is fitted immediately below the valve, with two bucket leathers, one above the other, each being held in place by a back nut.

MOTION PICTURE APPARATUS.—O. ANTONELLI, 108 Bay 49th St., Brooklyn, N. Y. The aim of this invention is to provide a motion picture apparatus which is extremely simple, and in which one unit shall be capable of taking as well as projecting the pictures. An object is to combine the essential parts of this apparatus in such way that they will function for the purposes of both photography and projection, thus reducing the initial cost as well as the subsequent expense to a minimum.

SAFETY SHUTTER FOR MOVING-PICTURE APPARATUS.—B. L. YOUNG, 1913 N. Second St., St. Joseph, Mo. An object of the invention is to provide a screen shutter unit which, during its operation, protects the film by intercepting a substantial percentage of the heat in the light rays striking the film, while at the same time permitting a proper amount of light to pass to the film. Another object is to provide a shutter unit which can be readily assembled and adjusted.

TYPOGRAPHICAL MACHINE.—L. C. TINSLEY, 1975 Creston Ave., New York, N. Y. The object of the invention is to provide means for compressing a line of matrices, and measuring the length of such compressed line in the assembler elevator of the machine, and also indicate the length of the space to be filled. The device is particularly adapted for use in setting up tabular matter, and may be used with columns of any width.

ADJUSTING MECHANISM FOR THE BREAKING ROLLERS OF FLAX-BREAKING MACHINES.—I. ETRICH, Oberaltstadt, near Trautenau, Bohemia. The invention relates to a means to simultaneously adjust the fluted breaking rollers of a large number of pairs of rollers. The invention particularly provides a means whereby the distance between the plurality of pairs of rollers may be adjusted in a predetermined ratio, and thus differentially adjust the several pairs.

FLOOR-OILING MACHINE.—A. WENGER, 432 Broadway, Bayonne, N. J. One of the principal objects of the invention is to provide a simple means for effecting an equal distribution of oil over the surface to be coated. A further object is the provision of means for regulating the flow of oil to an applicator member, and includes a plurality of interchangeable polishers and finishers capable of association therewith for various purposes.

APPARATUS FOR COOLING LARD, ETC.—C. S. HARDY, 710-722 6th St., San Diego, Calif. The invention relates to methods and apparatus designed for cooling melted lard as it comes from the tanks or kettles in the factories, and more particularly to an apparatus for cooling and mixing of fats of compound lards, composed of animal and vegetable fats, in a uniformly homogeneous product.

CHANGEABLE EXHIBITOR.—T. L. EASLEY, c/o Travelers' Hotel, San Antonio, Texas. An object of the invention is the provision of an illuminated, changeable exhibition in which the arrangement of the reels and web is such that the number of signs which are successfully and intermittently displayed is materially increased without appreciably increasing the number of parts of the mechanism.

SCUTCHING MACHINE.—I. ETRICH, Oberaltstadt, near Trautenau, Bohemia. This invention relates to the scutching or beating and bending operation to which flax is subjected following its passage through the breaking machine. The patent provides an assemblage whereby the flax is subjected to successive scutching operations and treated alternately at each end with a view to effect a more complete scutching.

DRIVING MEANS FOR SPRING MOTORS.—A. V. WILSON, Bar Harbor, Maine. An object of the invention is to provide a motor, including a power spring, which is adapted to drive a power shaft, and which is arranged to be rewound either continuously by a suitable winding mechanism or intermittently by a coacting strike-plate and lever arrangement, which may be so disposed in a floor that persons walking across the strike-plate will cause the automatic rewinding of the spring.

Medical Devices

DENTAL IMPRESSION TRAY.—V. M. ROBINSON, P. & S. Building, St. Joseph, Mo. The invention relates to an impression tray especially adapted for taking partial impressions, its object is to provide a device adapted to the varied requirements of individual cases, and in difficult cases wherein the tooth is undercut or has a bulbous crown, and which in all cases is effective to secure a distinct, clean-cut and true impression.

RESPIRATORY APPARATUS.—G. ANSTON, 937 Belmont Ave., Chicago, Ill. The invention relates to medical or curative apparatus, for bringing about a thorough and effective circulation of blood and nerve fluid of the body and brain, by first drawing out of the body impure air and forcing clean, fresh air into the body. The object is to provide a simple apparatus which may be efficiently utilized in home or self-treatment, beneficial results being obtained with little trouble or loss of time. (See Fig. 3.)

Musical Devices

PHONOGRAPH RECORD CLEANING ATTACHMENT.—J. RUNK, 235 S. Main St., Stillwater, Minn. An object of the invention is to provide a device arranged to be attached to the tone-arm in advance of the reproducer needle, so as to move over the sound grooves ahead of the needle to wipe out accumulations of dust from the grooves and insure a clearer and more faithful reproduction of a recorded sound wave. A further object is to provide a device made either in the form of a brush or from a fabric of velvet, silk or other suitable material.

SOUND-MODIFYING DEVICE FOR PHONOGRAPHS.—J. R. PARRISH, c/o Nashville Blue Print & Supply Co., 8th floor, Life and Casualty Bldg., Nashville, Tenn. The object of the invention is to provide a device which may be easily and expeditiously attached to the needle holder of a phonograph without changing the construction thereof, and when attached is adapted to soften and lower the volume of sound waves produced by the instrument. The device will in no way impair the clearness of the musical sounds.

Prime Movers and Their Accessories

INTERNAL COMBUSTION MOTOR.—J. T. COOK, 550 Central Ave., Newark, N. J. The invention relates more particularly to motors commonly known as the two-cycle type. One of the objects of the invention is to provide a motor of the two-cycle type in which the cylinder is cleared of burnt gases by introducing the fresh charge thereto under pressure. A further object is to so construct the motor that no valve driving mechanism is employed, and that the several parts may be easily disassembled when necessary.

CARBURETING BURNER.—E. P. HERPIN, Box 845, DeQuincy, La. The object of the invention is the provision of a burner including as a part thereof a combustion chamber and means for thoroughly carbureting the fuel and especially one in which provision is made for the primary combustion of the fuel, secondary combustion of which takes place in the space to be heated, with which the burner is connected.

CIRCUIT CONTROLLER FOR IGNITION SYSTEMS.—J. H. STEARNS, c/o Washington Missionary College, Tacoma Park, D. C. The invention relates generally to an apparatus for controlling the ignition system of an internal combustion engine, and particularly to a circuit controller which is governed by the lubricating system of an engine for automatically distributing the ignition system and giving a visual indication when the oil in the system is insufficient to properly lubricate the engine.

PACKING GLAND.—L. B. JOYNER, c/o L. S. Hass, Opelousas, La. An object of the invention is to provide a form of packing gland that is particularly adapted for application to a cylinder of an internal combustion engine. A further object is to provide a practical means for effecting a light between a cylinder and the parts associated therewith in such a manner as to permit such associated parts to satisfactorily perform the functions for which they are designed.

LOCK FOR INDUCTION COILS.—H. F. MAGUIRE, 168 East End Ave., New York, N. Y. The object of the invention is to provide a combined testing and locking device for ignition systems, and is especially designed for use in connection with the ignition system of an internal combustion engine. An object is to render the function of all of the coils inactive whereby to provide in effect an anti-theft device in connection with a testing device.

HYDROMETER.—B. L. CAMPBELL, 60 E. Chicago Ave., Chicago, Ill. Among the objects of the invention is to provide a hydrometer to be used with storage batteries which are charged by dynamos driven by internal combustion engines, the main purpose being to provide a hydrometer which indicates the amount of fuel to be used in the engine to run the dynamo for charging the battery to a predetermined point.

INTERNAL COMBUSTION ENGINE.—J. E. and T. R. EVERETT, Cochran, Ga. This invention relates to engines of the four-cycle type, its purpose is the provision of an engine in which the deterioration from wear of the work cylinder and work piston is materially reduced by the employment of means to receive the sideway thrusts, and to relieve the work cylinder and piston of all duty except that of performing the operations of the cylinder, whereby trouble resulting from leakage past the piston is eliminated.

ROTARY ENGINE.—A. J. ANDERSON, 553 Atlantic Ave., Brooklyn, N. Y. Among the objects of the invention is to provide an engine in which there is a rotor having one or more abutments formed integral therewith or rigidly secured thereto, there being provided means to admit the expansive medium in predetermined quantities at the desired moment with respect to the position of the abutments, the entire structure being simple, compact and well balanced.

Railways and Their Accessories

FREIGHT CAR DOOR.—J. LYONS, c/o Edlund, R. 9, Union Depot, Ogden, Utah. Among the objects is to provide a door which will buckle when the car bulges and at all times conform to the shape of the side wall of the car so that it will not jam when the box car becomes old and gets out of shape. A further object is to provide a track upon which the door slides, and a housing for the track which will effectively protect the same from dampness in inclement weather.

CAR WHEEL RERAILING BLOCK.—W. MATNEY, Box 190, Stone City, Ky. The object of the invention is to provide a pair of blocks whereby a derailed car may be replaced upon the track. The device consists of an outside and an inside block, a guide-rib on the top surface of each block adapted to cooperate with the flanges of the car wheels to guide the wheels toward the rails and a tiltable platform on the top of the outside block adapted to rest upon the adjacent rail.

TROLLEY WHEEL.—E. T. THAYER, Box 668, Charleston, West Va. An object of the invention is to provide a trolley wheel which is durable in construction, smooth and even running in operation and easy and inexpensive to manufacture. A further object is to provide a wheel which is so organized as to possess in assembly all the features of a unitary construction and at the same time provide for easy removal and replacement for repair.

Pertaining to Recreation

TOY.—H. MANES, 441 E. 187th St., New York, N. Y. The invention relates to gyroscopic aerial tops. An object is to provide an attractive toy for playing various games in which one or more persons may enjoy the sport, and in which the qualities of skill, judgment and luck play proportionate parts in the operation of the same.

CAR FOR PLEASURE RAILWAYS.—H. E. RIEHL, c/o H. E. Tudor, 35 Hawthorne St., Brooklyn, N. Y. Among the objects of the invention is to provide a pleasure railway car comprising a truck, a car body, a pivot pin connecting the car body with the truck, the truck and the car body having annular concentric grooves and tongues one engaging the other, the center of the grooves and tongues coinciding with the axis of the pivot pin.

DRAFT MEANS FOR THE CARS OF PLEASURE VEHICLES.—H. E. RIEHL, c/o H. E. Tudor, 35 Hawthorne St., Brooklyn, N. Y. The invention relates to amusement apparatus for use in pleasure resorts. An object is to provide means adapted to be engaged by the traveling chain for carrying the car to the top of the up-track, and means for preventing shock with the engagement of the chain with the draft means.

AMUSEMENT DEVICE.—W. C. HADLEY, 3 East 43d St., New York, N. Y. This inventor has been granted three patents of a similar nature for amusement devices to be used in connection with automatic or self-playing pianos. The objects are to provide a plurality of heads of persons or animals which are so constructed that when placed upon the white keys of a piano the movement of keys raises and permits the lowering of the tongues so as to simulate the opening of the mouths. A further object is to combine with such pictorial representations a separate base member provided with independent flaps which may be positioned under the heads over the white keys.

JUVENILE BLOCKS.—W. C. HADLEY, 3 East 43d St., New York, N. Y. The invention relates to blocks which can not only be used in the manner in which such blocks are commonly used, but also may be used in combination with a self-playing or automatic piano. The object is to provide blocks having upon their surfaces a picture of the upper part of a head, either of a person or an animal, which when placed upon the white keys of a piano, one of the keys will simulate the lower jaws of the head, and as it rises and falls give the impression that the head is opening and closing its mouth.

TOY.—W. C. HADLEY, 3 East 43d St., New York, N. Y. The object of this invention is to produce a toy which may be positioned over the white keys of a self-playing or automatic piano and as the keys move up and down, the toy will operate to simulate a dancing figure.

AMUSEMENT APPARATUS.—F. R. CHESTER, 312 W. 93d St., New York, N. Y. The object of this invention is to provide an amusement apparatus for use in pleasure resorts, exhibition grounds, fairs and like places, and arranged to enable a number of players to participate at the same time and with equal chance of all the players to successfully play the game in the shortest time. The game consists of mechanically inflating toy balloons under air pressure until the first one bursts, thus finishing the game.

AMUSEMENT DEVICE.—H. E. K. HINGENITZ, c/o General Delivery, Miles City, Mont. The invention relates to a pleasure railway, commonly known as a "loop-the-loop." The object is to so construct a pleasure railway with a safety device that any possibility of the vehicle carrying the passengers leaving the track and resulting in an accident is precluded.

TOY.—L. HINZ, 334 Rector St., Perth Amboy, N. J. The invention relates to a miniature representation of a flying machine or other moving object with spring motor means for revolving the miniature on a plane around a vertical axis. The device is durable, of simple construction and readily operable by children, and is adapted to furnish a high degree of amusement without liability of injury.

AMUSEMENT DEVICE.—G. C. WEISS, Box 148, Oakland, Calif. This invention has reference to a playing board on which the alphabet and other indicating characters are written, and a pointer which, when the fingers of one or more persons are lightly rested thereon, will move without conscious volition or effort, and develop mediumistic messages by means of the pointer cooperating with the indicating characters on the board.

Pertaining to Vehicles

COMBINED WAGON AND AUTOMOBILE TRUCK DUMPING AND WEIGHING PLATFORM.—J. MEYER and F. J. MANSEAU, 529 Mall St., Portland, Ore. An object of the invention is the provision of an apparatus which is entirely self-contained in the sense that it eliminates the necessity of making any connections in the mechanism or parts either before or after weighing, and a further object is the provision of an apparatus which may be controlled and actuated through the simple operation of a readily reversible electric motor.

TRACK.—G. KUNKLE, 125 Grand Ave., Grand Junction, Colo. This invention relates to tracks for vehicles, which will eliminate the necessity of building expensive roads in inaccessible places. An object is to provide a track which is made in sections which will conveniently accommodate motor vehicles, and which can be quickly laid down or taken up. A further object is to provide a track which is useful as a traffic link in regions occupied by industries such as mining or lumbering, or for elevated traffic in congested cities.

SIGNAL LAMP.—E. S. ROBINSON, 810 Lincoln St., Oroville, Calif. The primary object of the invention is to provide a readily adjustable lamp for automobiles and motor cars in connection with readily and easily operable means for adjusting the same so that a signal may be given to other vehicles at turning or stopping points.

DISTRIBUTOR.—J. F. ARMATHES, c/o Plymouth Auto and Supply Co., Plymouth, Pa. The invention relates to automobile ignition systems and more particularly to an ignition distributor for Ford automobiles, which will avoid the use of individual vibrators in the high tension connections and will permit of the use of a single vibrating coil so that the disadvantages due to lag in the usual individual vibrators will be avoided.

CHAIN APPLICATOR.—D. C. FARRAN, Rowan, Iowa. The invention relates to a device for attaching anti-skid chains in position upon the rear wheels of an automobile without leaving the driver's seat or without stopping the car, without touching the chain or applying the same by hand in the usual way, the chains for both rear wheels being simultaneously applied or removed as desired.

WHEEL.—C. E. WIGGINS, Box 101, Delhi, La. The invention has for its object to provide a wheel especially adapted for use with automobiles, but capable of use in any vehicle, wherein the resiliency of a pneumatic tired wheel is obtained without the liability to puncture or other injury, the resiliency being provided by telescoping spokes which are normally spring supported.

TIRE ARMOR.—J. PLUM, 193 Hewett St., Bridgeport, Conn. The invention has particular reference to a protective armor including a plurality of sections adapted to be associated with tires for rendering the same puncture-proof, and eliminating to a large extent wear on the tread surface, it also further functions to prevent skidding and to provide an effective tractive surface. The device is circumferentially adjustable, rendering it applicable to tires of various sizes.

DIFFERENTIAL TRANSMISSION GEARING.—P. V. TROUPE, Central Y. M. C. A., Moline, Ill. The invention has for its object to provide a differential unit so constructed that a greater percentage of the engine power is available for driving the vehicle, and in which the stresses and strains, due to the transmission of power therethrough, are uniformly balanced so that the wear on the unit is reduced and its life correspondingly increased.

HYDROMETER.—W. E. DIEBOW, Box 154, Lankershire, Calif. The invention relates in general to hydrometers, and more particularly to a hydrometer adapted for use in testing storage batteries of automobiles. The object is to provide a hydrometer which is a non-conductor, which will not be rendered inaccurate by virtue of variations in temperature and which will be always available to accurately test the storage batteries of automobiles.

ROAD INDICATOR.—J. CAMPBELL, 3214 Prospect Ave., Cleveland, Ohio. An object of the invention is to provide a road map in the form of a strip wound upon reels and to provide means for automatically exposing that part of the strip which indicates the particular road over which the vehicle is passing, and also indicates the direction to be taken when cross-roads are reached. The device may be conveniently mounted on the dashboard of an automobile.

DIFFERENTIAL GEARING.—F. E. CRAWFORD, c/o First National Bank, York, Neb. It is the purpose of this invention to provide a differential gearing which automatically limits its scope of differentiation, neither preventing or allowing of complete differentiation so that power is supplied to both wheels at all times. The invention allows of maximum differentiation, yet prohibits any greater differentiation, while at the same time permitting either wheel to act anywhere between the ratio of 3.5 while the other wheel is compensating from 5.3.

TRACTOR WHEEL AND SCRAPER.—F. P. ARNOLD, R.F.D. No. 3, Watkins, Minn. The general object of the invention is to provide a wheel presenting a duplex head with an annular clearance space between the individual treads. A scraper is arranged to coact with the duplex treads to yield to the pressure of a stone or other hard substance if wedged in the wheel and turning therewith.

RADIATOR.—A. BRETAGNE, 512 Main St., Wakefield, Mass. The invention relates to radiators of the type used in connection with motor vehicles, the object is to provide a radiator formed from sections independent of each other, and connected with common collectors or manifolds and so arranged that any section may be cut out from the circulation and removed without effecting the remaining sections.

CHILD'S VEHICLE.—C. SOLLIMA, 13 Rue des Abbesses, Paris, France. The invention relates to a child's vehicle, consisting of an apparatus more generally known as "patinette," in which there is provided a propelling mechanism comprising two driving pedals connected through a convenient gearing with the rear axle of the apparatus, so as to permit of the propulsion of the vehicle without having to bring the feet into contact with the ground.

TANK.—A. BEILE, P.O. Box 1094, Casper, Wyo. An object of the invention is to provide a tank adapted to contain liquids and which is mounted on an automobile truck. A further object is to utilize otherwise lost space for hauling fuel, oil or other liquid, which need not be removed in hauling freight other than fuel, which can be built in any desirable shape and which provides means for heating the liquid in cold weather.

STEERING GEAR.—A. HANSEN, 1262 Nelson Ave., Bronx, N. Y. The general object is to provide a steering gear for motor boats in which the cable runs endlessly through the quadrant and through the cable-actuating means operated by the steering-post and is adapted to be shifted to take the worn portion away from a point of severe wear and present to the wearing point an unworn portion of the cable, thereby materially prolonging the life of the cable.

STEERING DEVICE AND BRAKE FOR TRACTORS.—O. L. LEWIS, 336 W. 65th St., Chicago, Ill. This invention is applicable to any machine of a nature permitting of controlling the direction of movement of the vehicle by disconnecting the source of power from the wheel or wheels at one side while those at the other side continue to rotate under power. The primary object is the provision of a simple and convenient mechanism capable of control by flexible lines in the hands of the operator, and is applicable to various types of tractors.

TRACTOR STEERING AND CONTROLLING DEVICE.—H. P. HAMER, R.F.D. No. 1, Spring Valley, Ill. An object of this invention is to provide a device having means connecting with the steering mechanism of a tractor for guiding the latter from a trailer and having additional means for controlling the clutch mechanism of the tractor from the trailer. A further object is to provide means connecting with the steering mechanism of a tractor to hold the wheels in normal position to insure travel of the vehicle in a straight direction.

ADJUSTABLE STEERING WHEEL.—V. W. PAGE, 300 Lafayette St., New York, N. Y. The primary object of this invention is to provide means whereby the steering wheel of a motor vehicle may be angularly disposed with relation to the driver's seat. A further object is to so construct the mechanism that the steering post is locked and thereby maintained in its adjustable position.

DIRECTION INDICATOR.—A. F. LAMB, 244 Beach 81st St., Rockaway Beach, N. Y. The invention contemplates the provision of a device which will effectively indicate the intention of the driver to turn or stop following traffic. One of the principal objects is to provide a simple, inexpensive and compact indicator which is applicable to any standard form of vehicle now in use, and one which is located within convenient reach of the operator.

LOCK FOR SPARE RIMS AND TIRES.—E. H. BENEDICK, address E. E. Kincade, Box 121, Huntington, W. Va. The invention relates to a device for locking a spare rim and tire to the bracket or carrier positioned at the side or rear of a vehicle for carrying such spare parts and more particularly for a lock therefor adapted to prevent a straight side rim or a clincher rim upon which is mounted a tire casing from being lost from the bracket or removed by an unauthorized person.

PET-COCK OPENING AND CLOSING DEVICE.—J. H. ROUSE and A. M. DELIGNE, address W. A. Calvin, 2125 Polk St., San Francisco, Calif. While relating in general to accessories for automobiles, the invention refers more particularly to a tool for opening and closing pet-cocks which are ordinarily located in more or less inaccessible places on the motor of an automobile but which must be opened and closed at certain times. One of the objects is to provide a tool which may be manufactured at low cost, easily applied and capable of use with great efficiency.

AUTOMOBILE REAR SIGNAL.—A. DAVIS, 105 Orient Way, Rutherford, N. J. This invention has for its object to provide a construction wherein signals will be provided and connected to the front part of the automobile in such way that the driver may indicate different conditions, to be seen from the rear, at any time. Another object is to provide signals for the rear of an automobile and operating mechanism therefor which is operable independently of the automobile mechanism but coacts therewith.

POWER TRANSMITTING DEVICE.—T. J. WEEKS, c/o Weeks Motor Sales Co., Montgomery, Mo. An important object of the invention is to provide a power transmitting device having means whereby the power from a Fordson tractor may be transmitted to a binder so as to operate the binder when the bull wheel of the same cannot obtain traction with the ground. Another object is to provide a device which may be applied to the tractor without altering the construction of the same. (See Fig. 4.)

TRANSMISSION MECHANISM.—E. S. STOWERS and J. W. SCOTT, Bluefield, W. Va. The invention relates to mechanism having means whereby the transmission gearing is temporarily disconnected from the driven and driving mechanisms during the interval when the speed changing mechanism is being operated, thereby preventing breakage by the accidental engagement of rapidly moving parts. The purpose is to provide mechanism which is automatically operable to bring the gears to a dead stop as soon as the speed-changing mechanism is disconnected from the driving and driven mechanism. (See Fig. 5.)

SELF-LOADING VEHICLE.—J. B. VON CANON, West End, N. C. This inventor has been granted two patents of a similar nature, their purpose being the provision of a loading vehicle of simple and compact construction which is in the form of an attachment whereby it is rendered applicable to motor trucks of standard construction for effecting a loading of the truck as it moves along over the material to be introduced into the vehicle. The invention is particularly designed, although not necessarily, to the loading of motor trucks with road-making materials, such as gravel, sand, and the like.

SAFETY FOOT THROTTLE FOR AUTOMOBILES.—E. J. CURRIER, 601 Chester Ave., Ottumwa, Iowa. The object of the invention is to provide a convenient, safe and effective arrangement controlling the supply of gas to the intake of the motor. As applied to a Ford automobile certain other advantages result, including the adaptability of the foot control to the opening of the throttle beyond the point at which the hand lever may be set, and the automatic return to the hand set position whenever the foot control is released.

SPRING WHEEL.—J. A. LIVINGS, 2318 Congress Ave., Houston, Texas. The purpose of this invention is to provide a wheel having resilient extensible spokes which support the hub in such manner that when the wheel is applied to the axle of a car, the car is resiliently suspended from the top of the wheel rim, whereby a resilient support is provided which absorbs and thus prevents transmission of vibrations from the wheel to the axle. It is also a purpose to provide a wheel having stabilizing means for preventing lateral movement of the rim or hub when the wheel is making sharp turns.

STOPPING DEVICE FOR STEERING APPARATUS.—P. D. BENBOW and W. E. BECK, 518 No. Liberty St., Winston-Salem, N. C. The invention relates to a stopping device for limiting the movement of a steering apparatus of an automobile to prevent locking of the apparatus in one extreme position or the other, such locking being a common occurrence and causing accidents. The device is directly attached to the front axle and is adjustable to such point as to form an abutment on the spring arm of the steering apparatus to limit the movement.

TIRE MOUNTING.—L. J. PERKINS, Room 9, Beach Block, Lewiston, Idaho. The object of the invention is to provide a mounting of the character specified adapted for use in motor vehicles of any character, wherein the edges of the shoe or casing are so arranged that they may be pressed tightly together to seal the casing, and wherein means is provided in connection with the rim for securely clamping the edges together. (See Fig. 6.)

SYSTEM AND APPARATUS FOR CONTROLLING MOTORS.—A. K. ALLISON, 66 Webster St., Hartford, Conn. The object of the invention is to provide a compact and simple apparatus whereby the movements of a motor are definitely controlled, whether the motor is moving in one direction or another. A further object is to provide a controller which is adapted to control the motor by a minimum number of operations, and to provide means whereby the movement is effectively braked at suitable intervals during the operation.

SIGNALING DEVICE FOR AUTOMOBILES.—A. MCLAREN, 303 Putnam Ave., Brooklyn, N. Y. The object of the invention is to provide a signaling device for automobiles and other vehicles, arranged to signal to a following vehicle whether the automobile is going straight ahead or intends to turn either to the right or to the left. Another object is to combine the usual tail light with the signaling device, and to permit the installation of the device with automobiles as now generally constructed.

SEGMENTAL CASING FOR TIRES.—R. N. INK, 4627 Forty-second St., San Diego, Calif. The invention relates to pneumatic tires, and a particular purpose is the provision of a tire casing supplemented to the ordinary tire casing and constructed in such form as to be superimposed thereon when the latter is unduly worn or punctured, and thus, in effect, provide a new casing. It is also a purpose to provide such casing in a multiplicity of segmental sections, held so as to allow of ready removal of any one section independently.

TRUCK ATTACHMENT FOR AUTOMOBILES.—J. ANDERSON, 504 S. First St., Yakima, Wash. The principal object of the invention is to provide an attachment that may be easily and quickly applied to the frame of a pleasure vehicle to convert the latter into a truck, as well as to provide for the ready removal of the attachment to restore the vehicle to its original character. A more specific object is to so form the truck frame and its appurtenances as to stiffen and prevent sagging of the same or the frame of the chassis when the two are united.

ARMORED PNEUMATIC TIRE.—G. M. STIVERS, Dixon, Calif. This invention relates more particularly to an armor construction involving readily removable or replaceable elements capable of forming a non-skid surface. An object is the provision of an arrangement which may be readily adapted to and removed from a pneumatic tire, which includes readily removable and renewable tractive elements which will be simple and inexpensive and durable and efficient in use.

GATE FOR DUMPING TRUCKS.—H. MECKING, 1044 Hale Place, Bronx, N. Y. The object of the invention is to provide a gate for endwise dumping on automobile or power-driven trucks, or for sideways dumping on railroad cars, and arranged to insure an automatic opening of the gate on swinging the body into dumping position. Another object is to prevent dirt from lodging in the joints, thus insuring free opening movement.

SHOCK ABSORBER FOR DRIVE SHAFTS.—A. B. MANCHESTER, 2412 Juliet St., Los Angeles, Calif. Among the objects of the invention is to provide a shock absorbing mechanism which will serve as a cushion either between the transmission and the differential or between the engine and the transmission of an automobile driving mechanism, and which will prevent sudden strains and jerky motion of the car when the clutch is thrown in or the emergency brake applied.

MUFFLER.—H. C. and E. E. EMMONS, No. Syracuse, N. Y. An object of this invention is to construct a muffler in which the gases will travel through a much greater length of channels than is the case in a conventional muffler, and will be so altered that the gases will merge in the form of a steady stream by reason of the twisting action imparted. A further object is the provision of a simple form of muffler which may be manufactured at a low cost.

MOTOR CAR.—A. LANDINI, Cameri, Italy. The invention refers to a motor car of simple construction, in which the parts are so designed as to realize a substantial saving in weight and size, the whole portion of the carriage length heretofore allotted to the motor and radiator being saved without prejudicing the accessibility of the motor.

Designs

DESIGN FOR A GAME BOARD.—R. H. COTTER, 859 St. John's Place, Brooklyn N. Y.

DESIGN FOR A TOY BROOM.—R. NAKIAN, 207 Summit Ave., West Hoboken, N. J.

DESIGN FOR A LAPEL BUTTON ANCHOR.—W. FISCHER, 67 Cortlandt St., New York, N. Y.

DESIGN FOR A RADIATOR SHELL.—G. S. DUARTE, 119 Mowbray Place, Kew Gardens, L. I., N. Y.

DESIGN FOR A HOLDER FOR TOWELS AND OTHER ARTICLES.—C. A. MICHAELS, 137 Pierson St., Jamaica, New York.

DESIGN FOR A CANDY CONE WITH STEM.—J. GOLDBERG, 226 Herzl St., Brooklyn, N. Y.

DESIGN FOR A VALVE.—O. L. WHITEMAN, c/o American Valve Co., Coxsackie, New York.

Fig. 4. Device for transmitting power from a tractor, patented by T. J. Weeks

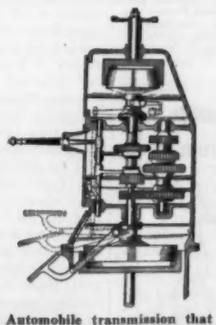


Fig. 5. Automobile transmission that avoids the risks of stripping gears in shifting, invented by E. S. Stowers and J. W. Scott

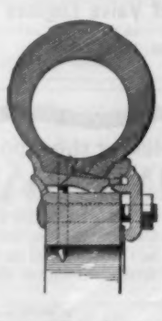


Fig. 6. Tire-mounting of universal applicability, developed by L. J. Perkins

Science Notes

Macmillan Reaches Baffin Land.—Continuous bad weather dogged the Macmillan party until they made the west coast of Baffin Land on August 15th; here they planned to establish winter quarters. Latitude and longitude differ so from the chart that they are impossible of identification; they agree with that of Jackman Sound, never found since Frobisher named it 345 years ago. No Eskimos had appeared when Macmillan wrote of his arrival. The Annapolis wireless time signals were heard every day.

Yosemite Museum Relics.—This new Government museum already has a wonderful collection of Indian basketry, beautiful arrowheads chipped from volcanic glass, and an important geological exhibit. It has the only existing specimen of a Piute rabbit blanket, woven from strips of the tanned skins of many rabbits; then there is a soft, pliable water bottle, still usable despite its 200 years of age, woven in a stitch that is a lost art, a stitch so close that no resin was needed to make the bottle watertight. Letters written by John Muir are also numbered among the treasures.

Dessicated Vegetables.—When dehydrated raw vegetables are stored in airtight containers at ordinary temperatures investigations show that their moisture content is an important factor in their preservation. There is a "critical moisture content" below which the distinctive color and taste is retained unimpaired for upward of six months. For cabbage this is from 3 to 3.34 per cent; for onions from 5.74 to 6.64 per cent. There is more injury from exposure to an atmosphere of comparatively high humidity at lower temperatures than from similar exposure in a dry atmosphere.

Insanity in Moving Pictures.—The leading character of a motion picture recently shown in the theaters of Paris is a man suffering from paretic dementia. The characteristic symptoms of the disease are developed on the screen in a masterly manner. Delusions of grandeur, change of personality, and maniacal excitement lead on to murder and incarceration, and finally to death by apoplexy. Undoubtedly an alienist was called in to supervise the depiction of these symptoms. The realism is intense, but from that very intensity objections are arising, with the warning that predisposed spectators may be hurried into a state similar to that portrayed by the chief actor.

The Relationship of Absolute Magnitude to Space-Velocity.—A statistical study of the radial, tangential, and space-velocities of 1350 stars, mostly of types F, G, K, and M, reported in the *Astro-Physical Journal* by W. S. Adams, G. Stromberg, and A. H. Joy, shows a marked correlation with absolute magnitudes. The results are given in the form of equations and tables. The increase in average space-velocity for a decrease of one magnitude in brightness varies with the type, but is of the order of 3 km/sec. The greater homogeneity of the giant stars as a class and their comparative freedom from large individual motions are indicated by the results. As would be expected for a random distribution of velocities as to direction, the average radial velocities are about half the corresponding average space-velocities.

Mutual Influence of Fraunhofer Lines.—The dispersion theory of Fraunhofer lines, which assumes that the lines are almost entirely the effect of anomalous refraction and scattering, was developed by W. H. Julius some years ago and led to the prediction and discovery of the mutual influence of neighboring Fraunhofer lines for which conclusive evidence is presented in the paper. The existence of this effect, not otherwise explained as yet, is considered by Julius to powerfully support this theory. He concludes, in a recent article in the *Astro-Physical Journal*, that anomalous dispersion is a most effective, perhaps the only, cause of the entire limb-center shifts and must, therefore, also produce center-arc shifts. If so, the gravitational shift required by the general relativity theory may not exist. Of the 866 lines for which the limb-center shifts were measured at Mt. Wilson in 1910 or at Kokaikanal Observatory in 1914-16, 128 have close companions which may be expected on theoretical grounds to influence their position. A study of the observations shows that there is, without doubt, a mutual influence equal, on the average, to two-fifths of the normal limb-center shift, a companion on the violet side causing an increase, a companion on the red side a decrease, of the shift.

Miscellaneous Notes

No Artists Wanted.—Throughout Old Lyme and Hamburg, Conn., you are welcome to wander over farm property—unless you are an artist. Signs everywhere forbid artists to trespass; the reason given is that many cows have been poisoned by paint-encrusted rags thrown away by the colorists.

Early History of Pleasure Travel.—Traveling for pleasure came into vogue in the peaceful years of the Roman Empire. Historic places and natural curiosities were sought out and famous groves and grottoes visited. The Romans seem to have preferred these gentler aspects of nature, and had little appreciation for towering heights and plunging canyons.

Toll of London's Fog.—The worst fog since 1902 visited London at the end of last November. It is estimated to have cost the city $3,000,000 for each of the three days it lasted. Trains were delayed, omnibuses tied up, and 60 laden vessels lay helpless off Gravesend, while 20 miles away the sun shone brilliantly. Health and property suffered alike, and six men were drowned by walking off piers. This fog was due entirely to smoke, and a new campaign was launched by the Coal and Smoke Abatement Society with the object of having abatement measures passed.

Giving Birds a Bad Name.—The Biological Survey warns us against charging the crimes of the English sparrow to other members of the sparrow family which, although essentially seed-eating, performs great service in its raids on insects. Even jays, crows, ravens and blackbirds, when not too numerous, do about as much good as harm. The best policy seems to be neither deliberately to persecute nor protect them. The owl, too, has a bad name, yet 50 varieties feed on rodents and have other useful habits, against which the occasional murder of a chicken is negligible.

Chinese Buyers and Color Prejudices.—The exporter to the Orient would do well to recognize the fact that the Chinese have strong prejudices as to the colors used in materials, wrappers, and poster advertising, often changing their patronage for no other reason. In general, red, yellow, gold, bright brown, purple, and certain shades of pink are looked upon with favor; white and blue are mourning colors, and green is associated with misfortune. It is well to leave the designing of posters and the get-up of advertising matter to agencies in China that are fully in touch with local tastes and superstitions.

Paper Dependent on Foreign Supply.—In 1920 two-thirds of our newsprint was from wood grown on foreign soil. We paid $191,000,000 for imported pulp wood, wood pulp and paper, and have become to this extent dependent upon markets beyond our control. As the Forest Service pointedly states, we have mills without forests in the East, and forests without mills in the West. Alaska, with its generous growth of spruce and hemlock, has but one mill. All this means increased cost and high prices. Nor can Canada be looked to indefinitely as a source of supply. The logical remedy is to build more mills on the Pacific slope while reforesting the East. Skill, money, energy and time are demanded by this program, but vastly higher penalties will follow our present indifference.

Our Place in the Book World.—The English-speaking population of the British Empire is, according to the 1921 census, 64,778,266; the population of the United States is 105,683,108. There are significant conclusions to be drawn from these figures, which show us to exceed in numbers, by about 60 per cent, all other English-speaking peoples put together. Since we are well in the van as to literacy, and occupy the foremost place in the circulation of books through public libraries, it is not too much to expect that within a decade we may become the largest distributors of English language books. Statistics are lacking as to the present book demands of different countries, but with the looked-for extension of our library system we may hope to reach an additional 60,000,000 of our population. What we do know is that in the per capita purchase of books we are steadily progressing—that new readers are constantly being added to the old army. The importance of these developments, whether we regard books as trade products or from the higher ground as promoters of good understanding between peoples speaking the same language, can not be overestimated.

New Starrett Tool for Measuring Thickness of Boilers, Flues, Tubing, Etc.

The L. S. Starrett Company has recently placed on the market its new No. 175 Micrometer Caliper Gage, especially designed to facilitate the quick and accurate measurement of the walls of cylindrical forms through a drilled hole or other convenient point of access.

Owing to its peculiar construction, this tool renders exact readings as easy to obtain upon curved forms as upon flat material.

The gage is furnished with two interchangeable anvils permitting measurements from 0 to 2 inches by thousandths of an inch. It is also equipped with the Starrett micrometer lock nut and ratchet stop.

The No. 175 Starrett Micrometer Caliper Gage is now in extensive use by U. S. Government Inspectors, and is recommended for general use in testing boilers, flues, tubing, drawn die work, etc.

Also a thickness gage, but one quite different from the micrometer caliper described in the preceding paragraphs, is the Starrett No. 170 Dial Sheet Gage for measuring the thickness of sheet metal, fibre, paper, cloth, celluloid, etc.

Suppose, for instance, you want to measure the thickness of the paper on which this is printed. If you have a Starrett No. 170 Dial Sheet Gage, you can get the exact dimension in a jiffy. A slight pressure on the thumb button permits the sheet to be inserted between two contacts. Release of the pressure causes the thickness of the paper to be instantly indicated on the dial.

With this instrument the thickness of any material up to .150 inches can be accurately measured by thousandths of an inch.

New Supplement to Starrett Catalog Features New Tools

Both of the tools outlined in the foregoing are illustrated and described in detail, with other new and interesting Starrett Tools, in a special Supplement to the Starrett Catalog No. 22 "B." Copies of both Catalog and Supplement may be had free by applying to The L. S. Starrett Company, Athol, Mass.

Civil Engineering Notes

The Simplon Tunnels.—When trains begin running through the now completely pierced second Simplon tunnel in January, the first tunnel, which parallels the second, will be closed for a time. The tremendous overhead pressure has weakened the roof, which must be considerably reinforced. It is especially weak south of where the two tunnels join at the center; that is, on the Italian side.

Traffic Effect on Bridges.—The effect of every shock and blow delivered by moving vehicles in crossing a bridge is measured with scientific precision by a new instrument devised by the Bureau of Public Roads. Attached to the bridge structure, this instrument makes a photographic record of the effect of the moving load. The device will greatly contribute to safety in building and maintaining bridges.

Tunnel vs. Airplane.— Several British dailies, as well as semi-scientific and technical organs, have been speculating recently on this topic, and expressing a more or less definite belief that the projected construction of a Channel tunnel might never be carried out because of the very strenuous competition which air transport would be in a position to offer by the time such a tunnel could be completed and got into operation.

Street-Car Routes in many of our large cities are largely the result of the same casual upgrowth that has determined the layout of the streets themselves. Few of our largest municipalities would fail to benefit from an engineering survey of these routes with a view of rearrangement. Such a survey was recently made in New York, and no layman can examine the recommendations of the committee without appreciating the improvement in service which would result from their adoption.

Newfoundland Water Power.—A total of 235,000 horsepower is estimated as the probable output of a project which comes from a rather surprising locality. The development is to be undertaken of the Humber Valley, Newfoundland, with the expenditure of $7,000,000 within the next two years. The power project is tied up with logging and other operations in a way which will involve the permanent employment of 1500 men in the works and 2000 more in the woods. The paper resources of the island will be very largely expanded by the new development, which is actually under contract at the present writing.

Wood-Seasoning Investigations.—The air-seasoning of wood is still in the rule-of-thumb stage; hence the experiments now being conducted by the Forest Products Laboratory in cooperation with sawmills and wood utilization plants, to determine piling practice that shall result in the fastest drying rates consistent with least depreciation of stock, least amount of required yard space and lowest handling costs, should settle the question whether lumber should be dried partly at the mill and partly at the utilization plant, or completely dried at the mill; and also the comparative desirability of air-seasoning and kiln-drying.

Movements in Concrete Roads are of a surprising variety and a surprising amplitude, according to preliminary observations on the Pittsburg, Cal., experimental highway, which is to be tested to destruction. Irregular longitudinal buckling or wave movement of the individual slabs occurs, with contraction cracks at the crests of these waves; warping of the cross-section is far more pronounced than had ever been imagined, the edges cupping up at night and curling down in the daytime; and temperature differences are observed of as much as 7 degrees between top and bottom of the pavement, the top being, of course, colder in the morning and warmer in the afternoon.

The Snow Removal which was planned by several States for the purpose of keeping highways open during the past winter has been particularly effective throughout New Jersey and Pennsylvania. In the former State the very heavy snowfall of January 28-29 at no time led to blockade of the larger through routes, while Pennsylvania was able, with the exception of temporary local blockades due to serious drifting, to keep the entire Lincoln Highway open throughout the winter. New York City likewise was singularly successful in getting its streets quickly cleaned up after the few heavy snows that fell. Unemployment, combined with some very effective sweeps, plows, shovels and loading machines, were the chief means by which these results were effected.

Mechanical Engineering Notes

Cement Tile.—It is reported by one manufacturer of cement tile that over 50,000,000 feet of his cement tile have already been used for the roofing of large plant buildings. This material makes excellent roofing, being fireproof, weatherproof, and having long wearing qualities.

The Photostat.—Tracing, and even copying, are all right in their places; but since the invention of the photostat these places are not quite so inclusive as they were. For many purposes a photostatic copy of drawings, specifications, etc., is quite as satisfactory as any other; and there is no comparison under the head of cost.

Belt Salvage.—Leather belts that have been retired from service need not be regarded as a total loss, if an article in *Machinery* of January last is taken as text. A method of restoring the belts to service after reinforcing them with woven cotton fabric is described in sufficient detail to make possible the application of the instructions given.

White Paint and Machines.—Much is written and said these days about the necessity of proper lighting in the factory, and lighting engineers have done some very useful things to our shop walls and windows. A new "stunt" of considerable interest in this direction consists in the liberal application of a coating of white paint to the lathes, planers and other machines about the shop.

The Interchangeable Pyrometer.—To those who have been in the habit of looking upon the thermocouple as essentially a cut-and-try affair, whose calibration must be done separately for each couple and with much pains, it will come as a shock to learn that there is now on the market a pyrometer whose thermocouple can be replaced by the user when replacement is necessary. Such a pyrometer is obviously much cheaper in use than one in which the couples must be bought completely assembled.

Wear on Tolerance Gages.—James Parker, in a recent issue of *American Machinist*, makes a point which is obviously a good one, but which we do not recall having seen brought out explicitly until now. In practically every case where a pair of go and not-go gages is used the design of gage and piece gaged is such that one gage makes contact with all the passed pieces, and gets continuous wear, while the other gage makes contact only with the oversize or undersize minority and accordingly gets little wear. In most shops it is probably the practice to discard the gage when it shows wear beyond a definite limit. It is suggested that in many cases a revision of the tolerance demanded in the direction that leads to this wear would leave the product in just as good shape as before, and save much gage expense. A "go" plug gage, for instance, made to exact size wears out almost immediately, and one on which the gage-maker makes even a slight minus tolerance is partly worn out before it is ever used.

Machining Aluminum.—Aluminum enters so largely into machine construction today that it is necessary to study closely its characteristics from the machining standpoint. Some excellent practical advice on the subject is given in a handbook published by the British Aluminum Company. The company has investigated thoroughly the numerous aluminum alloys with a view to determining their machining qualities and the most suitable treatment. For turning, drilling or milling a high speed is found best, and the tools should have acute cutting edges, preferably finished on an oil stone. For the clearance angle of a lathe tooth 15 degrees to 20 is advised, and with the smaller angle a 5-degree top rake may be given. Cutting speeds of about 600 feet per minute are permissible, and a heavier and faster feed than with brass may be employed. For screwing purposes a special alloy is supplied, and paraffin is recommended as a lubricant instead of turpentine, which tends to leave a resinous deposit that may cause the screw to bind. In milling the best results are said to be obtained by the use of a built-up tool, the cutters being ground with sharp corners. The cutters should only cut at the extreme points and not have a scraping action as with brass. Cutting speeds of 500 to 600 feet per minute are commonly used. When grinding aluminum the wheel should first have a piece of paraffin wax held against it to fill up the pores. A wheel so treated will not cause the metal to adhere to it and will not require to be so frequently dressed.

Patents and Trade-Marks Notes

Trade-Mark "C. & C."—A recent trade-mark decision is of marked interest to the public at large. In this case, Cantrell and Cochran Company, Ltd., firmly established its rights to the trade-mark "C. & C." for ginger ale, particularly in combination with the word "Belfast." The decree in the case in question recently issued by the Supreme Court of the District of Columbia, enjoins a firm of local bottlers from using the trade-marks complained of and directs the surrender of, and forbids the use of, any labels bearing such infringing marks, which would tend to deceive the public as to the brand of ginger ale sold.

Commercial Success as Evidence of Invention.—The importance in resolving any doubts as to the question of invention, of commercial success and practicability, is very frequently dwelt upon by the courts in decisions in patent cases. Such commercial success in itself does not constitute evidence of invention, but it has great effect in resolving any doubt in regard thereto in favor of the inventor. In a recent decision the United States Circuit Court of Appeals of the Third Circuit (Sandusky Foundry & Machine Co. vs. Laband, et al. 274 F. 607), held that even somewhat vague and general proof of commercial success is sufficient to constitute evidence of invention, in the absence of contradiction.

Recovery for Infringement of Patent.—In equity the rule for recovering for infringement of a patent is that where the net profits earned by reason of the infringement do not sufficiently compensate the owner of the patent for its infringement, there may, in a proper case, be awarded damages in addition to the ascertained net profits, and punitive damages may be awarded in the court's discretion, but ordinarily, the pecuniary gains arising from sales of an infringing article disclose the usefulness and commercial value of the thing invented, as well as its disadvantages, and may well constitute a guide to the true measure of damages. (Phila. Rubber Works Co. vs. U. S. Rubber Reclaiming Works, 276 F. 600.)

Effect of Later Patent, in a Suit Upon a Prior Patent.—It is a well-established principle of law that the issuance of a later patent is, prima facie, a presumption of a patentable difference between it and an earlier patent, as laid down in a number of decisions of the Supreme Court of the United States, for example, in Miller vs. Eagle Mfg. Co. (151 U. S., 186). Relying on this decision and others, the United States Circuit Court of Appeals for the Ninth Circuit, in Western Well Works, Inc., vs. Layne & Bowler Corporation (276 F. 465), again expressed the rule that the issuance of a later patent raises a presumption that the invention claimed is different from that of an earlier patent, and the burden of proof rests upon the complainant, to establish infringement. It must nevertheless be remembered that despite this presumption it is quite possible for a patent to be infringed by a machine or an article which itself may be covered by one or more perfectly valid, later patents, and the question involved is not one of actual infringement but merely of the burden of proof of such infringement.

Proper Names as Trade-Marks.—Anyone has the right honestly to use his own name in connection with his business, even though this use should interfere or injure the business of another, provided, however, that he uses every reasonable means he can to distinguish his own business and the merchandise which he places on the market from those of his competitor. In Stix, Baer & Fuller Dry Goods Co. vs. American Piano Co., 211 F. 271, the Court of Appeals in the Eighth Circuit said: "It is now settled beyond controversy that a family surname is incapable of exclusive appropriation in trade. The right of every man to use his own name in his business was declared in the law before the modern doctrine of unfair trade competition had arisen. It is part of the law of trade-mark. The subject may, therefore, be properly approached from that side. If, however, the name has previously become well known in trade the second comer uses it subject to three important restrictions: (1) He may not affirmatively do anything to cause the public to believe that his article is made by the first manufacturer. (2) He must exercise reasonable care to prevent the public from so believing. (3) He must exercise reasonable care to prevent the public from believing that he is the successor in business of the first manufacturer."

Electrical Notes

Summaries and Excerpts from Current Periodicals

Tokio Superpower System.—An American manufacturer has received orders from an electric company of Japan for electrical equipment to be used in two large hydroelectric plants, which are to form part of a superpower system in the Tokio district. The current is to be transmitted at 154,000 volts. The total value of the equipment is about $2,000,000.

Electric Steam Boiler.—The efficiency of the electric steam boiler of fire tube type is practically 100 per cent, according to the *General Electric Review*. This high efficiency is due to the fact that all the energy is expended inside the boiler, and if properly heat-insulated the losses from radiation are negligible. These boilers will appeal to engineers for the reason that standard boilers, transformers, governors and auxiliary devices are used.

Final Report on the Electrification of Railways.—The report of the advisory committee of the British Ministry of Transport presents the conclusions arrived at after thoroughly studying the operation of various systems of railway electrification and the extent and character of engineering regulations desirable to facilitate continuous travel over connecting railway lines. The principal recommendations of the investigation are not limited to British practice, but are of international application. These are: (1) That three-phase alternating current be the standard system of power generation; (2) that direct current be the standard system of power distribution; (3) that 1500 volts, a multiple or sub-multiple be the standard distribution potential; (4) third rail, the overhead wire, or both, to be the standard distribution conductor.

Telephoning Through Cables.—In a recent issue of the *Journal* of the Institute of Electrical Engineers (British) there appears a discussion of the nature of telephone transmission problems and the importance of the attenuation constant. The effect of varying the line constants is discussed and summarized in a table, and the improvement obtained by the addition of inductance in the form of loading is illustrated. Tables are given of the coil-loaded and continuously loaded cables that have been laid. The introduction of telephone repeaters necessitates a smooth impedance frequency curve for the cable, and this is more readily obtained with continuous loading. A comparison is made of the two methods now used in loading telephone submarine cable, showing that the balance of advantage is on the side of the continuously loaded cable.

Electrically-Equipped Furniture.—The latest novelty is electrified furniture, so to speak. It was first talked about in 1915, according to *Electrical World*, but it is only during the recent past that progress has been made in this direction. Electrified furniture is nothing more than furniture that has been wired and provided with suitable electrical outlets to facilitate the use of lamps or electrical devices. Thus the electrified bed is one in which outlets are provided along the edges of the bed so that a heating pad, reading lamp, milk warmer or other devices may be readily connected. An electrified tea wagon is provided with a pair of outlets at the rear, so that the electric coffee percolator, electric grill or electric toaster may be readily connected. The National Electric Lamp Association thinks well enough of the electrically equipped furniture to have drawn up a set of specifications.

Electric Locomotive Drives. — Brief comments on two lines of development, namely, the quill and the coupling-rod types, are contained in a recent issue of *Engineering*. Reference is made to experience of some American engineers, particular attention being called to some comparative tests of steam and electric locomotives. In conclusion, the writer says: "It is quite possible that in freight working, or, indeed, in such passenger service as is probable in this country for some time, the quill or direct-current drive may suffice; but there would seem, on the other hand, to be little doubt that the freedom in electrical design presented by the introduction of the coupling-rod drive, taken with the indisputable advantage of the higher center of gravity, will insure this machine a very good share of popularity, especially where easy running and good speed are sought for on curved roads.

Electricity in the Far North.—An article in the London *Engineer* of recent date contains a comprehensive account of one of the northernmost electrical developments in the world—that at the Porjus waterfall in the extreme north of Sweden, within the Arctic circle. This hydroelectric plant serves the industrial interests engaged in mining the immense deposits of iron ore made accessible by railroad construction in comparatively recent years, 5,000,000 tons of iron ore being now exported annually from the district. In deference to the tourists one waterfall above the Porjus development has been permanently reserved as a scenic feature. The Porjus water power is a combination of rapids and falls, one and a quarter miles long, which continue to the Gulf of Bothnia as the Great Lule River. Here three 10,000-kw. generators deliver energy at 80,000 volts over a 200-mile transmission line.

A Voltmeter That Measures in Hundreds of Thousands.—With the gradual increasing of transmitting voltages up to nearly one-quarter million volts, it is interesting to note a new voltmeter developed in England for the measuring of high potentials. The new voltmeter is based on the principle employed by Lord Kelvin, and subsequently developed by M. Abraham, the eminent French investigator, of the attraction of two oppositely electrified conductors protected by guard plates. The instrument can be built for measuring pressures up to 200,000 volts. The change-over from one range to another is immediately effected by altering the distance between the plates. An important feature of these voltmeters is that air being used exclusively as the dielectric, they give identical readings with direct current or alternating current of any frequency, which is not the case with electrostatic voltmeters depending upon the use of condensers.

A Novel Method of Road Illumination was employed for night racing at the Oregon State Fair last fall, according to a description in *Electrical World*. The lighting equipment consisted of 68 1000-watt, 120-volt lamps supported in enameled-steel elliptical angle reflectors equipped with special hoods made to receive "mogul" series sockets. The fixtures were hung at an angle of about 20 degrees from vertical. This was done so that the lighting units might be hung at least 10 feet from the edge of the track to keep the light as much as possible out of the racers' range of vision and at the same time give the proper distribution of illumination. The elliptical type of reflector was chosen because a wide distribution was wanted parallel with the track. The poles were spaced 240 feet apart on the curves and 320 feet apart on the straightaways. The use of the series system of circuits reduced the cost of the wiring materially and made it possible to use the messenger cable for the conductor by placing an insulator in the cable at each fixture.

Electrically-Driven Plows.—Two different types of electrically-driven plows have been recently built and tested by two French concerns, according to *Revue Generale de l'Electricite*. A small plowing set, built by Douilhet, consists of two little trailers each with a 13-horsepower motor-driven cable drum holding 500 meters of 6-millimeter steel cable. The two trailers are placed alongside of the field. Two stationary pulleys, anchored in the ground, lead the cable ends to the plow, which goes to and fro across the field. After each furrow the pulleys have to be reset, and after each 30 meters of furrows their anchorage has to be changed. A light self-turning plow is used. A large plowing set has two heavy trailers, each with two cable drums and one 60-horsepower motor. Two permanent anchor posts are provided, and both trailers move the width of one furrow after each cross-plowing. The small set will plow one, the large set three hectares per day, at an approximate cost of 96 francs and 80 francs per hectare, respectively.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Health Hints by Radio.—A semi-weekly "radio telephone health bulletin service" has been inaugurated by the United States Public Health Service. It is planned to broadcast every Tuesday and Friday through the naval radio station at Anacostia, Va., a message of advice or how the average man and woman may insure continued good health. Under very favorable weather conditions it is expected that the messages will be heard on the Pacific Coast, in Europe, and the north parts of South America.

Radio Telephone Broadcasting in France.—The popularity of radio broadcasting has extended far beyond our own borders. England is doing a little radio telephone broadcasting, so is Berlin, and the idea is taking real shape in France. We learn from a recent news dispatch that 20 ballet girls danced to music played 25 miles away, as a feature of a matinee. The performance was witnessed by Prof. Branley, the pioneer wireless worker, and ex-President Poincare.

Guiding Radio Waves.—A Ukrainian engineer is reported to have discovered a method by which radio messages may be sent to a definite receiving station without the danger of being intercepted by other stations. It is stated that by means of a simple apparatus the so-called "locked power line" of the magnetic field may be straightened out and grouped into parallel rays. These rays are said to do away with the necessity of aerials. If this report is true, it seems that we are on the verge of a new epoch in radio. However, we shall have to wait for complete details before passing judgment on the merits of this new invention.

Medical Service via Radio.—Arrangements have now been made whereby any ship provided with a radio outfit can receive prompt medical service from the United States Health Service, through one of several Radio Corporation of America stations and other stations. When it is remembered that only a small proportion of the total number of ships equipped with radio have a ship doctor, the value of medical service via radio becomes apparent. The ship in need of medical service can now call up the nearest radio station, state the nature of the case or cases requiring medical attention, and receive a diagnosis of each case and complete instructions as to treatment within a few minutes.

High-Power Vacuum Tubes.—In connection with Great Britain's Imperial Chain—a world-wide radio system that has been under way for a long time—the Technical Committee recommended the use of high-powered tube installations. A considerable amount of very valuable work has been carried out in the past year by the British Admiralty, working in conjunction with the Mullard tube builders. Much progress has been made in the construction of silica tubes, which have now been made in 10-kilowatt sizes. The result of this work will undoubtedly be seen in the forthcoming year. We may expect a large number of land stations operating on valves of large power.

Radio Equipment of the Ships "Paris" and "Lafayette" is described in a recent issue of *Radioelectricite*. On both steamers a 5-kilowatt tube transmitter has been installed with a wave range of between 2000 and 9000 meters. A 5-kilowatt motor-generator set is used to produce the plate high tension for four rectifying and four oscillatory tubes, and the low-voltage current for the heating of the filament of these tubes. Both vessels are equipped with a radio range-finder, or "radio goniometer," which, reduced to plain English, means a radio compass. A distance of 3400 kilometers has been covered safely by messages sent from the transmitter of the "Paris."

Armstrong's Victory.—By a recent decision of the United States Court of Appeals, the claims of Edwin H. Armstrong as inventor of the regenerative action or the feedback arrangement in radio reception and transmission, are again upheld, as against the claims of Dr. Lee de Forest. No trans-Atlantic telephone conversation can be carried on without use of the Armstrong principle; none of the big radio-phone broadcasting stations now sending music nightly through the air can operate except under the Armstrong patent; even the modern multiplex form of wire telegraphy and telephony must pay tribute to Armstrong, so it is claimed. Indeed, the Armstrong regenerative action or feedback constitutes one of the greatest advances ever made in the radio art.

The Radio Industry.—It is evident that the radio industry has expanded to undreamed of proportions within the past few months. It is not surprising, therefore, to learn that one concern expects to do a business of well over $50,000,000 this year, judging by the returns of the past few months. There is an ever-increasing demand for vacuum tubes; it is estimated that by this writing 75,000 tubes are being turned out a month, and that by the time this reaches the reader the production will probably exceed 100,000 tubes per month. Authorities in and out of radio are of the opinion that the radio business as it is now developing is going to be greater than the phonographic industry, which has been doing a business in excess of $400,000,000 per year.

Radio Link in Telegraphy.—Experiments on substitution of a radio transmission link for the customary wire transmission lines on the commercial multiplex printing telegraph, have recently been carried on. Results are given of tests made between New York and Cliffwood, N. J., a distance of 25 miles. The usual outgoing signals from the printer were transmitted by wire to the radio room, where by means of a relay controlling the radio transmitter they were converted into radio signals. The received signals at Cliffwood actuated a polar relay and converted the radio signals back to wire signals which were relayed by wire back to the printer laboratory in New York. These tests showed that 180 words per minute could be satisfactorily sent, according to the *Journal of the Franklin Institute.*

World-Wide Radio.—Every leading nation is interested in establishing a system of world-wide radio. Germany had such a plan before the war, which had a distinctly military tendency rather than a purely commercial attempt to keep in touch with all countries, both far and near. Great Britain has had a world-wide radio plan for many years, and of late the subject has been very much in the forefront of British circles. It is understood that the present plan considers six principal centers between which reliable radio communication is required, namely—Great Britain, Canada, Australia, New Zealand, South Africa, and India. Geographical considerations suggested the postponement of Canada and New Zealand. Of the remaining four, Australia, South Africa, and India form an equilateral triangle about 5000 miles along each side, while England is about 6000 miles from South Africa, 5000 miles from India, and 10,000 miles from Australia. The United States has also a plan for world-wide radio, which is rapidly progressing towards realization.

Efficiency of Radio Plants.—In a recent issue of *The Electrician* there appears the following editorial comment, which offers sound food for thought: "Apart from the press stunts, of which wireless has been the victim (or conspirator), the thing that most strikes the observer of progress in this branch of electrical service is the enormous disproportion between the hundreds of kilowatts utilized at the transmitting end and the few microwatts picked up at the receiver. No doubt this apparently inevitable state of affairs has had its influence upon those who have been engaged in the practical development of wireless, for it is only within recent years that any progress has been made in the rounding up and extermination of the losses which take place within the transmitting plant itself. The old spark transmitter had an efficiency in the neighborhood of 15 per cent, but it is only necessary to inspect the oil-cooling system of the high-frequency alternator, the water jacketing of the arc, or the red-hot anodes of the very latest transmitter, the 3-electrode valve, to realize that even present-day apparatus has far to go before it approaches the efficiencies now commonplace in low-frequency and direct-current work.

Aeronautical Notes

A Flying Friar.—A Capuchin friar has requested the Spanish Government to let him take part in the Moroccan campaign with a machine of his own invention.

"ZR-2" Inquiry.—It is found that the design of the "ZR-2" was never examined and discussed by any official committee before construction was begun. The Court of Inquiry finds the accident due to structural weakness.

A Prize of One Million Francs has been offered by the Administrative Council of the Committee for Aeronautical Propaganda in France, for an airplane engine which will give satisfaction in severe tests of durability, reliability, swift dismantling, erecting, etc. Tests will begin in June 1923. Competition is open to the world.

Taking Baby for an Airing.—The weathercock atop the 200-foot steeple of the parish church in Leister, England, was surrounded by rain, cold and fog, when three visitors arrived. They were Herbert Neville, 64, his son, 33, and his grandson, a fine 20-pound baby. Son carried grandson, while mother and grandmother anxiously watched the climb from the church tower.

Altitude and the Human Organism.—Mountain miners in the Andes do heavy labor in a rarified atmosphere that makes the slightest effort fatiguing to newcomers. American and Canadian scientists are in Peru to discover whether this immunity of the miners is due to changes in the blood or to other functions. The scientists will yield their own blood, both at sea level and at three miles altitude, and the samples will go to our universities for analysis.

Flights in Fog Made Safe.—A French navy lieutenant has perfected a system whereby the principle of the submarine cable for directing ships is now applicable to airplanes flying by night or in a fog. Two or three amperes of alternating current are sent over telegraph wires; electromagnetic appliances aboard the plane are tuned to the same frequency. The pilot is said to pick up vibrations easily from a distance of three miles, and to follow the wires without difficulty.

Fire Fighting by Airplane.—Paris, stirred by the 40,000,000-franc fire that consumed a big department store, is considering the equipment of air planes with fire-extinguishing bombs. These would be filled with a gas that chokes out the flames without being injurious to the neighboring population. Aviators proposing the plan claim one airplane could carry enough bombs to extinguish a large fire well under way. Experiments are to be conducted in the suburbs to determine the feasibility of the scheme.

Dirigible vs. Airplane.—The "ZR-2" disaster was closely followed by the destruction of the Navy balloons at Rockaway. From the time England's first big airship, built by Dr. Barton, crashed in its maiden flight at Muswell Hill, the history of large dirigibles has been full of failures. The airplane has progressed in size, safety, and speed from year to year. Its supreme importance as an arm of defense is unchallenged, and it might be better to let other nations dally with the expensive and dangerous gas bag, and to strive wholeheartedly for supremacy in heavier-than-air machines.

Gliding in Germany.—The gliding experiments of Herr Hans Richter have been attracting no little attention even from this side of the water. This German experimenter began his first experiments in 1908, and is said to be the earliest of all glider fliers now living in Germany. He is, in fact, the first German glider since the late lamented Herr Lilienthal, according to *Aeronautical Engineering*. In a recent glider tried by Richter, the aviator rests his elbows on the longitudinal members of the frame and controls the fore and aft attitude of the machine with an ordinary tail elevator operated by a short lever which is worked by a movement of the wrist. The machine is designed to be inherently stable laterally, and consequently no lateral controls are fitted. The aviator's own legs form the undercarriage of the machine. Altogether, Herr Richter has made more than a thousand flights with his various types of gliders, and with those of other constructors. It is noteworthy that the very keenest interest is taken in gliding in Germany, where gliding competitions with quite a large number of entrants have taken place in the hills of the Rhon.

CLASSIFIED ADVERTISEMENTS

The Market Place for the Small Advertiser

Advertising in this section is $1.00 a line. No less than five nor more than twelve lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Advertisements for insertion in July number should be received by May 20th.

AGENTS WANTED

AGENTS, 600% profit. Free sample. Lowest priced Gold and Silver Sign Letters for stores, offices, automobiles. Large demand. No experience necessary. $50 to $200 a week easy. Exclusive territory. Acme Letter Co., 2800 A Congress St., Chicago.

AGENTS. Here's big money—and independence. $2.50 invested nets $28.25 profit; $5.00 nets $83.00. Apply initials to side doors of autos. Every car owner a prospect. Newark Monogram Company, Desk 30, 568 Broad Street, Newark, N. J.

AMBITIOUS WRITERS

AMBITIOUS WRITERS send today for free copy, America's leading magazine for writers of Photoplays, Stories, Poems, Songs. Instructive, helpful. Writers Digest, 602 Butler Bldg., Cincinnati.

AMERICAN MADE METAL TOYS AND NOVELTIES

MANUFACTURERS WANTED on large or small scale, for production of metal toys and novelties. Toy soldiers, cannons, machine guns, cowboys, Indians, wild animals, whistles, bird whistles, race horses, baseball players, paper weights, match holders, automobile ornaments, souvenirs, advertising specialties, and hundreds of other things. No experience of tools necessary. Hundreds and thousands made complete per hour. Bronze casting forms furnished to manufacturers complete with outfit from $5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. An enormous business is offered to industrious men this year with an excellent opportunity to enter this open field. Write us only if you mean strictly business. Catalog and information free. Metal Cast Products Company, 1696 Boston Road, New York.

AUTOMOBILE OWNERS

FORD Car Repair Book sent free. This complete, well illustrated, valuable book explains in a simple way the Causes and Cures of Over-heating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustments and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car Repairing. Send 25c coin for three months' trial subscription and get the valuable repair book free. Ford Owner and Dealer Magazine, 301 Montgomery Bldg., Milwaukee, Wis.

AUTOMOBILE OWNERS — Garagemen — Mechanics—Repairmen—send for free copy of this month's issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages, illustrated. Send for free copy today. Automobile Digest, 542 Butler Bldg., Cincinnati.

50c for a foolproof automobile spring oiler! Car owners enjoy smooth riding! Compton Spring Oilers stop squeaking, clean, keep out rust, automatically lubricate springs. Send $4.00 complete set 8 oilers. Special Ford set 4 oilers $2.00. Profitable discount to wholesale dealers able to finance own stock orders. Compton Spring Oiler (16) Co. 29 Broadway, New York.

BUSINESS OPPORTUNITY

PARTNER wanted to finance the manufacture and marketing of Coin Sorting Machine. Fully protected by U. S. Patents. Will separate 2000 coins (of all denominations) a minute. Floor space, 12" x 14"—light and portable. All parts die made and interchangeable. Will sell for ten times its cost. For further particulars address W. L. Paul, Beaufort, N. C.

PROFITABLE sales by mail! Circularize newly compiled mailing lists 15,000,000 classified names. Example: 200,000 wealthy rural mail order buyers; 3,000,000 farmers (by states) $6.00 thousand. Responsible firm's offer. You'll want more. Lo Martinek Co., Corona, New York.

YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training; openings everywhere with all the trade you can attend to. No capital required or goods to buy; no agency or soliciting. Address Stephenson Laboratories, 23 Back Bay, Boston, Mass.

ELECTRIC railways, public utilities, water, timber, oil, industrial and mining enterprises promoted. Approved bond and stock issues placed with European bankers and brokers. Underwriting procured for corporations. Mining and other examinations and reports made by well-known engineers. Irish Minerals and Industrial Development Company, 12 Upper Camden Street, Dublin, Ireland.

I TRAVEL over entire United States, appointing territorial County and State distributors, and can represent another manufacturer who has a new Patented Specialty ready for the market. I must have control of the Sales end of the entire United States. Address Expert Organizer, General Delivery, Flushing, New York.

BE MORE SUCCESSFUL buying, selling, trading. Master dealer system makes real estate easy, safe, profitable. Guaranteed or costs nothing. Interesting booklet explains all. Send today. Instruction Dept., Stephens Realtor Service, Muncie, Indiana.

MANUFACTURER or Capitalist wanted to make and sell on royalty basis a new and novel feature double heat electric heater, reflector type. United States and Canadian Patents. Millions sold yearly. "Excelsior," Box 138, Scientific American, New York.

GRANDFATHER clock works, $5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Ruffner St., Philadelphia, Pennsylvania.

"SCHEMER MAGAZINE," Alliance, Ohio. 40-page monthly, prints big profit schemes; one subscriber making $25,000 from three, another $10,000 from one. Try your luck. Year, only $1.00; three months, 25c. None free.

RESPONSIBLE corporation wants general sales managers to open branch office, manage salesmen. $500 to $5000 necessary; expenses to Baltimore allowed if you qualify. Address Manager, 603 N. Eutaw Street, Baltimore, Md.

BUSINESS OPPORTUNITY

PATENTS. If you have a patent to sell or lease, send particulars to Supply and Demand, 1823 Broadway, New York.

GALVANIZING tire rims, awnings, signs, boat-fittings, spikes, bolts and contractors' material, and hundreds of other things exposed to the weather. Galvanzing a paying business requires very little capital to start. Address P. O. Box 583, Charleston, S. C.

EXPERIMENTAL RUBBER WORK

WE DO experimental compounding, vulcanizing, testing; chemical analyses; develop your rubber ideas, processes, inventions. Let us advise you. Consult us. Kent Rubber Laboratory, Consulting Engineering Chemists, Box 196, Kent, Ohio.

Mr. Advertiser:

Do you realize the opportunity that this Classified Department offers to you in broadcasting your wants or offerings to an audience of over one hundred thousand readers? Spread over the period of one month, it would take an organization the size of a metropolitan department store to accommodate this many prospective purchasers. Yet SCIENTIFIC AMERICAN, through the medium of the Classified Department, will effectively carry your message to this great assembly at a cost of approximately two mills a word for each thousand readers, or fifteen cents a word to reach the entire audience. At this rate the small advertiser is enabled to merchandise his products over a period of one month at a cost commensurate with the market that SCIENTIFIC AMERICAN affords.

The value of this market is manifested in the ever-increasing number of advertisers using space. If you are interested in having your advertising message broadcasted to this audience, send in a trial advertisement.

Classified Manager
SCIENTIFIC AMERICAN
Woolworth Building
New York City

FOR INVENTORS

PRACTICAL instructions to inventors and patentees written by the manufacturer and inventor, Charles Hunnicutt, covering every problem relating to inventions. Experience has shown the best means of patenting, manufacturing and marketing inventions. Written in the plain style of an honest man. No patent lawyer connections. For sale by Thos. Coonan, Exclusive Agent, 1231 North Capitol St., Washington, D. C. $1 prepaid. Satisfaction or money refunded.

INVENTOR and Manufacturer: Let us be your machine shop. We make models, build special machinery tools, dies and manufacturing. We have a modern daylight factory with precision machinery. Send blue prints or sketches for estimate. Victor Engineering & Mfg. Co., 2524 W. Chicago Ave., Chicago, Ill.

PATENTS. If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation. All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without expense to the client. Our Handbook on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc. "Scientific American" contains Patent Office Notes. Decisions of interest to inventors, and particulars of recently patented inventions. Munn & Co., Solicitors of Patents, 626 Woolworth Bldg., New York; Scientific American Bldg., Washington, D. C.; 801 Tower Bldg., Chicago, Ill.; Hanna Bldg., Cleveland; Hobart Bldg., 582 Market St., San Francisco, Calif.

FOR INVENTORS

INVENTIONS.—If you have one we may develop and market it for you. Special facilities, confidential service, square deal. Castonguay Engineers, Thompsonville, Conn.

FOR SALE

PATENTS No. 1,390,054 U. S. and No. 203,506 Canadian for sale outright or on royalty basis. A valuable article in universal demand. Manufacturing cost small. It will pay you to investigate. M. G. McNeely, Tulare, Calif.

WILL SELL non-refillable bottle patent at worth while price. For more details write to D. G. Abels, Chehalis, Washington.

How to Build Beautiful Homes At Small Cost. Read My Book on the Twentieth Century Building Materials. Price One Dollar. Peter de Linde, Zion, Ill.

SELL YOUR property quickly for cash, no matter where located. Don't pay big commissions. Particulars free. Real Estate Salesman Co., Desk A, Lincoln, Neb.

DRAWING INSTRUMENTS, slide rules. Highest quality, lowest prices. Direct from importer, circulars free. Automotive Engineering Co., Castle Hall, Indianapolis, Ind.

HEMSTITCHING and picoting attachment works on any sewing machine, easily adjusted. Price $2.50 with full instructions. Oriental Novelty Company, Box 11, Corpus Christi, Texas.

HELP WANTED

RESEARCH ENGINEER

An attractive position with exceptional opportunities for the future is open to a man having the right qualifications. The position requires ability to apply sound scientific principles and reasoning to the analysis and solution of a very wide variety of general technical problems demanding fundamental research. These problems are mainly in the general field of mechanical engineering, although many of them are typical problems of physics and chemistry, some of them requiring special mathematical ability.

Applicants for this position should have had not less than five years of active experience in research along the lines indicated above. They should have had advanced scientific as well as engineering training, with special regard to fundamentals rather than to details of engineering practice.

Such courses of instruction, for instance, as lead to advanced degrees in physics, chemistry and mathematics, with special reference to mechanics, and thermodynamics are of much importance. Equally important is a sound knowledge of practical engineering problems and appreciation of the various factors which must be considered in applying scientific analysis to these problems. The applicant should state particularly the lines of engineering with which he is familiar and the extent of his acquaintance with other engineers in these lines.

Ability to summarize scientific and technical papers and to write up technical material for publication is of importance, as is ability to maintain cordial relations with other engineers engaged in similar lines of work.

State when available and salary. Box 139 Scientific American.

BE A DETECTIVE. Earn big money. Great demand everywhere. Excellent opportunities for travel. Fascinating work. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, New York.

MAIL ORDER METHODS

$30 A WEEK, evenings home—I made it. Sample article and plan 25c. Booklet for stamp tells how also you can earn $10 a hundred stamping names on key checks. Sample and instructions 25c. Alsets Scott, Cohoes, N. Y.

PERSONAL

EXCHANGE cheery letters with new friends! Lots of fun! Send stamped envelope for information of our exchange plan. Betty Lee, 28 East Bay Street, Suite 19, Jacksonville, Florida.

RADIO

BUILD RADIO SETS. We supply parts or complete units. Catalog 15 cents. Easily understood assembly drawings, Crystal Detector Set, Non-regenerative Receiver, Regenerative Receiver, 2 Step Amplifier 25 cents each. All five $1.00. No stamps accepted. Hatfield Airfone Company, Owego, N. Y.

"RADIO FOR EVERYBODY"—352 pages profusely illustrated with an accurate description of all types of receiving sets and wiring diagrams adaptable to your particular location, with instructions of how to make them. Written by an authority on radio in plain understandable English. Gives the rudiments of radio for beginners and hook-ups for the advanced. Bound in cloth $1.60 postpaid. Dept. C, Box 773 City Hall Station, New York City.

SCIENTIFIC INFORMATION

SUCCESS or Failure? Which is your destiny? Scientific information. "Success" pointers and Personality sketch for 10c and birthdate. Thomson-Heywood, Dept. 85, Chronicle Bldg., San Francisco, Cal.

STAMPS

FREE! Sectional Loose Leaf Postage Stamp Album at the rate of 8 pages each month given with subscription to our monthly Journal. Send two-cent stamp for prospectus. United Stamp Co., 140 S. Dearborn St., Chicago, Ill., Dept. S.

STAMPS — 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c; 50 different U. S., 25c; 1,000 hinges, 10c; 1,000 mixed, 40c. List free C. Stegman, 5952 Cote Brilliante, St. Louis, Mo.

WANTED

AMBITIOUS MEN: $40.00, $150.00 weekly. Become advertising writers. Students frequently earn $20.00, $40.00 weekly while learning. Prepare quickly at home spare time. We assist you to position. Write Applied Arts Institute, Dept. 297, Witherspoon Bldg., Philadelphia.

Book Reviews

CONNECTING INDUCTION MOTORS. By A. M. Dudley, B.S. in E.E. New York: McGraw-Hill Book Company, 1921. 8vo.; 252 pp.; illustrated.

The material of this volume was originally a series of articles answering in a general way many actual questions relating to induction motor connections and the possibilities of making changes to meet varying conditions of voltage, phase, etc. While written mainly from the repairman's viewpoint, it has much that will tend to solve the problems of operating engineers and make smooth the way of armature winders. The work is rich in good diagrams.

SOARING FLIGHT. A Simple Mechanical Solution of the Problem. By Lt.-Col. R. De Villamil (late R.E.). New York: Spon and Chamberlain, 1920. Paper; 12mo.; 48 pp.; illustrated.

An entertainingly written pamphlet reviewing research in the soaring or sailing flight of birds, clarifying the factors to be considered, and advancing a theory that accounts for the bird "trapping energy" from the air without the expenditure of propulsive effort.

TECHNICAL DICTIONARY IN FOUR LANGUAGES. Edited by Edoardo Webber. New York: Isaac Pitman and Sons. 16mo.; 921 pp.

Ordinary two-language dictionaries fail lamentably as aids to the understanding of foreign technical terms. The student-reader will find this "Technical Dictionary" just the compact supplementary aid he so often requires. To the right of the English word appears its Italian, German and French equivalents, all in parallel columns, with no necessity for turning the page.

THE WAY TO GREATER PRODUCTION. By Homer S. Trecartin and others. New York and Chicago: A. W. Shaw Company, 1920. 8vo.; 252 pp.; illustrated.

An urgent question of the industrial world is here put, and wisely answered by a number of men in the best of positions to tell what has been done toward its solution. The worker must be assisted to the needed knowledge and training and thus made the conscious master of his powers; and proper incentive must be provided in order to bring out his increased capabilities. Actual instances of successful campaigns of this sort are cited. The work concludes with a glance at the problems of factory management.

ELEMENTS OF MECHANISM. By Peter Schwamb, S.B., Allyne L. Merrill, S.B., and Walter H. James, S.B. New York: John Wiley and Sons, Inc., 1921. 8vo.; 372 pp.; illustrated.

Instructors who found this text to have many elements of appeal for technological students have suggested numerous changes that are embodied in this third edition. The work's chief claim to attention lies in the admirable selection and disposition of the material, which has resulted in a practical guide to the groundwork of the subject.

20TH CENTURY GUIDE FOR MARINE ENGINEERS. By J. A. Ramsey, Warrant Machinist, and J. Rosbloom, C.M.M., Instructor. Philadelphia: David McKay Company, 1920. 8vo.; 537 pp.; illustrated.

Reciprocating engines, boilers, turbines, gas engines and Diesel engines are painstakingly explained by two naval experts. The mathematics takes nothing for granted save ability to add and subtract; the problems are eminently practical. Among other things, condensers, ice machines, lubricants and electricity are adequately covered. A hundred questions and answers are a valuable feature of the arrangement.

REVOLUTIONARY THEORIES IN WIRELESS. By Frank E. Summers. Memphis, Mo.: Frank E. Summers, 1920. 8vo.; 194 pp.; illustrated.

Mr. Summers' book is in part an illustrated description of apparatus and experiments that familiarize students with wireless practice and related subjects, and in part an expression of his dissatisfaction with accepted theories, together with theories of his own that he hopes may simplify certain branches of science.

FIELD METHODS IN PETROLEUM GEOLOGY. By G. H. Cox, Ph.D., E.M., C. L. Dake, M.A., and G. A. Muilenburg, M.A. New York: McGraw-Hill Book Company, 1921. 8vo.; 305 pp.; illustrated.

This new work covers the initial stage of one of our most important industries. Competent geologists have found a remunerative field in this specialization of their science

and have accomplished great things in the analysis of the structural conditions peculiar to oil territory. New methods have been developed and old methods adapted to new needs. Means and methods are fully discussed in this excellent handbook, which takes up the minutiæ of field procedure, presents geologic criteria, and carries the student through details of procedure to the final report.

WORKING CONDITIONS, WAGES AND PROFITS. By C. W. Price and others. New York and Chicago: A. W. Shaw Company, 1920. 8vo.; 254 pp.; illustrated.

Qualified writers and large manufacturers have joined hands in this attempt to answer the vital questions indicated by the title. The results of the various wage systems are analyzed and compared; there is an experience meeting as to the value of profit-sharing; most factors of loss and gain, as they touch the worker, are taken up illuminatingly; and the result is a book of authoritative findings and tested plans that meets the present demand for answers to these urgent questions.

THE ESSENTIALS OF ADVERTISING. By Frank Leroy Blanchard. New York: McGraw-Hill Book Company, 1921. 8vo.; 322 pp.; illustrated.

The author has selected with rare judgment such phases of advertising as best demonstrate the groundwork of modern practice. He starts the beginner aright, and gives him a sound knowledge of the comparative advantages of the mediums employed, of the duties of the more important positions, and of many other primary considerations. The easy-step arrangement of lessons and the many illustrations spell gratifying progress for the serious worker.

THE END OF THE WORLD. By Joseph McCabe. New York: E. P. Dutton and Company, 1920. 8vo.; 267 pp.; illustrated.

"The End of the World" is a brightly written, unbiased account of the recent discoveries of astronomy, and of the attitude of science toward the death of the universe. It is popular writing of the best order, conforming cautiously with the more solid contributions found in technical journals, reconciling apparently conflicting views, and stressing the permanent truths. All is kept well within the intelligence of the inexpert reader, and made undeniably interesting.

PATTERNMAKING. By Joseph A. Shelly. New York: The Industrial Press, 1920. 8vo.; 341 pp.; illustrated.

A competent patternmaker must know a great deal besides the construction of his forms. He should be familiar with molding problems, for there is close relationship between these and the types of patterns; he must know joinery, and the adaptability of hand and power tools to particular kinds of work. These factors are expertly set down before the treatise turns to the general subject of pattern construction. To the student of patternmaking, and also to the draftsman, the work will be exceptionally helpful.

PHYSICS OF THE AIR. By W. J. Humphreys, C.E., Ph.D. Philadelphia: J. B. Lippincott Company, 1920. 8vo.; 665 pp.; illustrated.

Reprinted from the *Journal of the Franklin Institute*, these papers brings together from many sources descriptions and explanations of the numerous and complex phenomena of our atmosphere. They clarify its mechanics and thermodynamics, deal with electricity and auroras, investigate atmospheric optics, and summarize and discuss the factors of climatic control. Methods of observation are set forth in text and illustration. As a member of the staff of the Weather Bureau, the author has had opportunities and aids accorded but few, and his work is correspondingly valuable to all students of atmospherics.

THE NEW STONE AGE. By Harrison E. Howe. New York: The Century Co., 1921. 8vo.; 289 pp.; diagrams and photographs.

Cement and concrete have insinuated themselves—on their merits, be it said—into nearly every branch of engineering, so that there is a solid basis of truth for Mr. Howe's title. His alluring work, while scientific in standpoint, is couched in popular language, and the elements of suspense and surprise make it a gripping story. Past history, raw materials and their preparation, the part played by chemistry, and exactly what happens when the ingredients set and harden, these are the themes of the book, accompanied by thirty-two fine illustrations that gratify the eye and inform the mind.

Stoking the Employee

(Continued from page 322)

are more wholesome than inordinate quantities of ice water, or, perhaps, a bit to eat.

As an illustration of present Steel Corporation practice, four lunch-rooms at three western plants seat from 130 to 260 and require from 26 to 38 employees to run them. The average number of seats per restaurant employee varies from 4.54 to 6.84; the number of meals served per restaurant employee from 27.6 to 74.1; the number served per seat at noon, the principal meal, from 2.8 to 5.6.

Approximately half as many breakfasts as dinners are served, and about as many suppers and midnight lunches each as breakfasts. The total daily average number of meals served at the four lunch-rooms ranges from 1521 to 2108. In the year 1920 the total number of meals served at the four lunch-rooms was 2,022,615. The average cost per meal to the employee in 1920 was 30 to 43 cents; at present the cost at all four places is 30 cents a meal. The Corporation aims to serve meals at actual cost of food and service.

The Westinghouse Electric and Manufacturing Company, a near neighbor of some of the Steel Corporation's important plants, goes to the opposite extreme in its views regarding the proper size for an employees' lunch-room. Instead of a number of small lunch-rooms scattered over an area giving employment to more than 25,000 persons in normal times, the Company decided on one enormous restaurant. The reasons influencing this decision must have been as cogent as those which determined the other great

(Continued on page 364)

Transmitting Power in Fluid Waves

(Continued from page 320)

severest tests, not only for wave transmission and hydaulic work, but for superheated steam, acids, etc. Being impermeable, inexpansible and leakproof, the transmission efficiency is very high.

It is an interesting fact that so long as waves are passing, the water in a pipe line cannot freeze; indeed, supposing a main to have frozen save for a thin core of water, waves passed through the system will melt the ice. In spite of this, there is no heat loss at normal operating conditions; heat generated in the high-pressure zones is absorbed in the low, and after the plant has been working for an indefinite time the pipes are cold.

Ten-horsepower waves have been transmitted through one-inch piping to a distance of 240 feet. But there is no theoretical limit to the transmission distance. The longer the line the greater the diameter required. The practical limit comes when the initial cost and the drop in efficiency compare unfavorably with the corresponding items in competing systems. The conditions for best efficiency are large diameter of pipes, high pressure and high frequency. Pipe diameter may be reduced as power is taken off at intermediate points. It is not necessary to provide Y-junctions for branch lines; square tees are equally efficient.

In addition to its applications here outlined to reciprocating tools, the system has definite advantages as applied to rotary motion and to heating. The possible range is therefore theoretically almost unlimited. To the present its scope has been limited, except experimentally, to systems where economy, convenience and safety are essentials. Compressed air has hitherto been used for safety and convenience, but its most fervid partisan can scarcely hold a brief for its economy. Wave transmission is already in the field in mining and in mineral treatment; its application seems at present to have touched only a fringe of the ultimate development. Experiments have shown that reduction gear for shipping use and for automobiles is practicable; and variable-speed motors for all purposes are already in sight. In short, there seems to be practically no industry using transmitted power which may not ultimately be intetrested in wave transmission.

Sugars of Great Price

(Continued from page 313)

There are several queer things about the next most expensive sugar, "mannose," at $125 a pound. In the first place, it is a bitter sugar if the lay mind can grasp such a paradox. Although it has a sweetish aftertaste, its initial taste is decidedly bitter. Also, it is extracted from button waste, the scraps left after buttons have been made from vegetable ivory. Furthermore, it is

also made from a sugar alcohol called "mannite," discovered as long ago as 1806 by Proust, in the manna of the Sicilian ash tree. Van Ekenstein first crystalized it in 1906 by a devious process and Harding developed a simple process for making it commercially from pants-button residue in 1919.

Next comes "rhamnose" at $100 a pound, which, like several other rare sugars, obeys the Eighteenth Amendment, for it will not ferment. However, certain bacteria can break it down into acetic, lactic and other acids, and that gives it its bacteriological job. First made by Rigaud in 1855, it is now manufactured commercially from black oak bark by a Harding process.

Next cheapest, at $90 a pound, is wood sugar, xylose, its very name suggesting that it ought to be cheap. It is plentiful enough, in the form of a condensation product, because xylans are found in straw, cottonseed hulls and corncobs as well as wood, but until Hudson and Harding took it up in 1917 it was known only by the gram, being so difficult to obtain. Now it is made 10 pounds at a time. A strict prohibitionist, xylose is not fermented by yeast; but it is one of the most useful in bacteriological work, unerringly picking out the criminal germs of typhoid, cholera, enteritis and other intestinal diseases.

Aribinose at $81 a pound was first made in crystal form from gum arabic by Kiliani in 1880, and is one of the most useful tools of the bacteriologist, but used only to a limited extent on account of cost until made in quantity about 1915.

Prices are coming down — presently we will find a few bargins. "Melezitose," "levulose" and "inulin" at $50 each per pound come next. The first is a trisaccharide or compound of three simpler sugars. Discovered by Bonastre in 1833, it is made from a rare manna found in Turkestan, and has only lately been available to scientists in working quantities, so it offers a wide field for study. "Levulose" is the sweetest sugar known, about five times as sweet as cane sugar, and occurs in honey as well as many fruits and vegetables, but is difficult to crystalize and for many years was known only in the form of syrup. Now it is manufactured in crystals, and promises to be better for diabetics than saccharine, which is not a sugar at all, but a complex derivative of benzene. From a dietetic and bacteriological standpoint, melezitose, trehalose and melibiose offer virgin fields of investigation. "Inulin" has been brought to highest purity by American chemistry for the first time.

Galactose at $15 a pound, maltose at $14 a pound, mannite at $9, dextrose at $3.60, lactose at $2, and saccharose at $1.50 about wind up the rare sugars thus far manufactured on a commercial scale. Galactose was first made by the great Pasteur in 1856, by boiling milk sugar with acid, and in our own destructive age has, like a good many other of the chemist's lesser-known discoveries, been perverted to the making of explosives. Maltose is malt sugar, widely distributed in nature, but difficult to obtain in the purity necessary for its useful work in identifying dysentery and diphtheria germs. Dextrose is common too, being our old friend glucose, which can be made from starch or even paper. It is, however, expensive to purify for use as a diagnostic agent. Lactose is another old friend — milk sugar, transformed into a rare sugar when highly purified; and saccharose is ordinary sugar-bowl sugar rendered aristocratic by being profusely refined and in a state of absolute chemical purity.

There are still possibilities for discovering new sugars. Two were found in Washington by Dr. F. B. La Forge — sedoheptose and d-mannoketoheptose. Many of them have been made synthetically, and the theoretical study of organic chemistry enables the investigator to predict what types of sugar he should find in nature, and then find them. A number of rare sugars already prepared synthetically have not yet been found in nature.

The latest discovery in this little-known industry is a sugar called "melibiose," made available commercially for the first time some weeks ago. Its raw material is raffinose, and it is so exceedingly rare in that product at $150 a pound that its market price has not yet been fixed. But it will certainly exceed the price of trehalose, and may be as high as $400 a pound. Should that be the rate at which the bacteriologist and analytical chemist add it, for the first time, to the delicate working tools in their kits, the term "rare" applied to these substances will be comprehensible, for at that price "melibiose" is valued at about two and a half times its weight in gold!

Stoking the Employee

(*Continued from page 362*)

corporation in behalf of the small lunchroom, for the huge Westinghouse restaurant was evolved from the free coffee protoplasm after long and careful study by the management.

The restaurant building, completed a little more than a year ago, on Braddock Avenue, East Pittsburgh, outside the Company's grounds about midway of the plant and some ten minutes' walk from the offices, is said to be the largest cafeteria in the world. So far as available information shows, it is the largest eating place of any kind for civilians. The building is a plain but neat-looking structure of brick and concrete, three stories and basement, 235 feet 9 inches long on the street front and 226 feet 8 inches at the rear by 99 feet 10 inches wide. There are neither elevators nor stairs in the building, all communication between floors being by ramps with maximum grades of 14 per cent.

The ground floor is divided into two rooms, one of which is for women employees. The second floor is thrown into a single room for men. The third floor contains the kitchen, dining-room for officers and foremen and an auditorium. Each room has a separate entrance and a separate exit, so that incoming and outgoing crowds are kept out of each other's way. By this careful segregation and by the use of conveyor belts for diners' trays, already referred to, and with a separate automatic conveyor belt from the kitchen to each of the eight service counters for replenishing the stocks of food, the noon rush is handled with incredible celerity without trace of confusion. The average time for a meal, entrance to exit, is 22 minutes.

The seating capacity of the building is 3200. Some comparative figures may be useful in arriving at an idea of the size of this eating place. The largest single meal served in a hotel or restaurant concerning which data are available was the Sixty-ninth Regiment dinner at the Hotel Commodore in New York two years ago, at which there were 3167 guests. A hotel serving 3000 meals from morning to night would be considered exceptionally large. The largest popular-priced restaurant in New York serves about 2000 meals a day. The Metropolitan Life Insurance Company serves 4500 or more lunches daily to employees at its New York headquarters, but they are fed in three relays. Thus, to serve 3200 diners at a single sitting is seen to be no mean feat.

For this undertaking a total of 135 restaurant employees is required. In addition to these 30 waiters are employed in the officers' dining-room. The kitchen is equipped with the customary power-driven meat and bread cutters, vegetable peelers and mashers, cake mixers, and so on, of the latest type. Dishes are washed on two automatic machines with a capacity of 14,000 pieces each per hour.

President Herr and his staff select their lunches from the identical menu provided for the employees, which may be an indication either that President Herr is very modest in his tastes, or that Westinghouse employees are extremely well fed. The only apparent distinction is that while the average check for girls is 17 cents and for men 37 cents, President Herr and his staff are required to pay a minimum of 45 cents per meal to provide for the luxury of waiters.

Taking the Riddles Out of Radio

(*Continued from page 299*)

leges cooperate in this work. During the Radio Conference, receiving and sending sets were installed in the halls of Congress and at the radio headquarters so that the representatives at the conference could listen in on the debates in Congress. A resolution was introduced in the House during the conference to broadcast the debates and daily doings of Congress throughout the country. It is anticipated that such a service would reawaken public interest in Congress and its daily affairs and controversies, and would admit of the accurate recording and dissemination of information about its actions. Many business firms find it essential to keep in close touch with Congress to know just what action is taken on different bills and measures. The actions of Congress and the times when they are taken frequently effect investments involving millions of dollars. The radio telephone is the most rapid medium for broadcasting such information. The time when a tariff bill goes into effect is of vital interest to a ship at sea bringing imports to this country. The passage of a bill limiting or regulating immigration is of equal importance to a liner brining in a ship-load of immigrants. The revived custom of the President appearing before Congress and making addresses would enable the general public all over the country to hear such speeches by means of radio telephone.

All the banking institutions doing an international business are awaiting the development of the radio telephone for their use. The radio telephone would have about the same relation to the cable that the long-distance telephone bears to the telegraph. The markets for foreign exchange and foreign bonds would be brought closer together by such a facility. Messages could be sent over distances as great as 7000 miles. The U. S. Shipping Board announced recently that one of its vessels anchored at Buenos Aires talked with another sister ship in the harbor of Honolulu. These two cities are 7000 miles apart, and this is reported to be a new record in wireless communication between ships at sea.

A novel use of the radio telephone which has been developed in Washington and was commented on favorably during the conference is the entertainment of soldier hospital patients by the use of the wireless method of communication. At Walter Reed Hospital, one nurse can entertain several hundred convalescing soldiers simultaneously by reading stories into the wireless transmitter. A phonograph can also be connected to the radio transmitter and music broadcasted through the hospital wards in this manner. The soldier patients snap in place small clips which connect with their bed-springs and put an instrument like a telephone receiver to their ears and listen to the latest popular melodies.

The Necessity of Scientific Forestry

IN an interesting article in *Science* for October 26, 1921, Professor J. W. Toumey of the Yale School of Forestry, in emphasizing the necessity of scientific forestry in this country says that industrial development proceeds faster in those countries in which domestic or imported wood is available in considerable quantities, and that industrial development becomes arrested when available wood supplies are reduced below the essential needs of industry.

China at one time was well wooded. Prior to the exhaustion of her timber supplies she reached a stage in civilization and economic development beyond that of most other nations. She exhausted her forests centuries ago and has been without wood adequate for her essential needs for many generations. Historians have assigned many reasons for the early arrest in economic progress by the Chinese. It appears, however, that the progressive destruction of her forests far below the point of essential wood needs made the development of other industries impossible or extremely difficult.

Japan, on the other hand, although surpassed in civilization and industry by China during the long period while Chinese wood was available in quantity, has never exhausted her forests and now has wood in abundance. There is every reason to believe that if Japan had followed China's example and had devastated and exhausted her forests and made no provision for regrowth, we would hear little of Japan today as a world power. Greece, once powerful and prosperous, fell from her high estate many centuries ago.

She swept the forests from her hills and mountains in attaining her power and in building her civilization. She neglected regrowth and lost her place in the sun. She is still without adequate wood for her essential needs. Switzerland, a small nation of mountains and hills, though poor in soil and most other resources upon which the strength of a nation depends, has retained her forests. She still has wood, a basic resource. As a matter of course she is prosperous and forward moving.

The republic of Switzerland, only a little larger than the State of Connecticut, has three million people tilling less than 20 per cent of the land. Some of the forests were organized as early as 853 A.D. They have been continuously under timber production for more than 1000 years and are more intensively managed and more productive today than ever before.

In conclusion, the author says that the forest history of the old world clearly proves that forests are overcut and otherwise destroyed when their control and management are left entirely to private land owners. No nation can perpetuate her forests through wise use unless they are publicly owned or publicly controlled.